TRANSPORT-USER SATISFACTION MODELLING –
APPLICATION TO THE BROKERAGE VEHICLE SELECTION PROCESS

by

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DEDICATION

To
The LORD God Almighty,
The Author of all Knowledge

ABSTRACT

General customer satisfaction studies link use and reuse of a commodity or service to the extent to which customers are satisfied. There is currently great interest in increasing transport accessibility, which in this context consists of the ease of reaching and using transport, and thus means are being devised to increase both the use and reuse of transport. This thesis investigates the use of customer satisfaction models in relation to the use and reuse of transport services.

Much of the transport for people with restricted mobility is provided by the Community Transport sector where the criteria for vehicle selection in relation to a particular person's proposed journey are currently vehicle availability, costs and time constraints, and the matching of passenger disability and vehicle capability. Beyond requirements related to the barriers to access found in the transport system, transport users do have other needs and preferences, such as safety, comfort, convenience, friendly crew, reliability, etc., that can affect their satisfaction with the service provided. Unfortunately, such a multi-criteria decision process makes it difficult for community transport managers and operators to take these preferences into consideration systematically when allocating transport to individuals.

This thesis develops a predictive model of transport satisfaction that can be used in such transport provision decision-making. A comprehensive list of travel attributes affecting transport-user satisfaction has been derived from the literature and confirmed through group interviews. For each of these attributes, a predictive model of satisfaction based on the level of service of the attribute, the user's prior transport experience and socio-demographic characteristics, has been derived. An overall transport satisfaction model has been developed from a combination of the individual attribute satisfactions. The model was validated by comparing its output to an independent dataset and a high level of similarity was observed. In addition, a framework for such a decision-making process for a community transport brokerage has been designed.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Central and local governments in the UK are putting efforts into making accessible transport services available to the transport-disadvantaged people in the society by encouraging and supporting, in the voluntary and public sectors, non-conventional transport such as community transport. In some community transport operations, transport is arranged and provided on a brokerage basis whereby the community transport management has access to a fleet of vehicles not all owned by them. While they may or own some of the vehicles, they will have vehicles not belonging to them that they also manage. In addition, they may have registered with them, private transport providers with whom they can also arrange for transport to be provided for their (the community transport) clients.

In such community transport brokerage operations, the criteria for vehicle selection in relation to a particular person's proposed journey are often limited to vehicle availability, costs and time constraints, and matching vehicle capability to passenger disability. Beyond requirements related to the barriers to access found in the transport system, transport users do have other needs and preferences (Sussman, 2000) with respect to travel attributes such as safety, comfort, convenience, friendly crew, reliability, etc., that can affect their satisfaction with the service provided and consequently, their quality of life. Combining the operators' and the users' criteria gives a complex multi-criteria decision process which often makes it difficult for community transport managers and operators to take these preferences into consideration systematically when allocating transport to individuals.

The lack of a tool by which these attributes can be considered systematically in the planning and provision of transport makes it difficult for community transport managers and operators to add to their selection criteria users' preferences for such travel attributes as those stated above. What is needed here is a consistent and objective means by which several travel alternatives can be compared for customer satisfaction so that the most satisfying service can be provided for each client. This is even more essential now, given the current paradigm shift towards customer satisfaction in organizations (MacDorman et al, 1994; TRB, 2000).

This thesis attempts to address this issue by presenting the development of a framework by which such a tool can be made available to transport managers. Thus it presents the development of a predictive model of transport user satisfaction incorporating these travel attributes, which can then be used in a transport selection process to rank transport alternatives according to the user's preferences. The thesis then describes the development of a decision support tool consisting of a relational database and the user satisfaction model.

1.2 RESEARCH OBJECTIVE

The aim of this research is to contribute to improving the quality of life for transport-disadvantaged people by developing a framework with which community transport managers and brokers can assess and incorporate in transport mode and/or vehicle selection processes, the travel attribute satisfaction preferences of their users in addition to the traditional criteria of cost and time window constraints. To achieve this aim, an understanding of the processes involved is necessary. These processes include the transport booking process and the user's satisfaction judgement process.

Thus, the following objectives have been set:

1. Understand and model the booking process of a transport brokerage.
2. Determine the abstract travel attributes of relevance to transport disadvantaged people.
3. Understand and model users' satisfaction judgement process i.e. the process by which the user integrates his or her experience of a multi-attribute system into an overall concept of satisfaction or dissatisfaction.

4. Incorporate the two models into a framework that would enable a transport broker identify and respond to an individual user's travel preferences.

1.3 RESEARCH STUDY

To achieve these objectives, a research investigation has been designed and involves the following stages:

1. Consultation with managers and staff of Community Transport operations.
2. Consultation with potential and actual users of Community Transport Services.
3. Design of relational database and programming framework.
4. Identification of user defined travel attributes.
5. Identification of system performance measures and level of service ranges.
6. Survey design and conduct.
7. Determination of satisfaction judgement functions.
8. Model validation and hypothesis testing.

1.4 RELEVANCE OF STUDY

This study has relevance to transport in the UK today, because there is a strong need to be able, to consider firmly and systematically, the needs, preferences and satisfaction of current and potential transport users, in the planning and provision of transport. A framework that enables a structured means of using predetermined travel preferences in selecting not just appropriate vehicles by an operator, but also in selecting operators for transport contracts, will be a useful tool. The emphasis on the mobility-impaired sector of the population is also relevant as they are the group with the most limitations to travel because of constraints due to age (very young or very old), health or finances.

1.5 THESIS STRUCTURE

This thesis is structured as follows:

- Chapter 2 presents the background to this study and the context in which the research is conducted.
- Chapter 3 presents a review of the literature on customer satisfaction formation theory and proposes a modification to enable the application of the theory in the development of a transport-user satisfaction model.
- Chapter 4 presents a review of methodology for satisfaction modelling and a review of travel attribute literature.
- Chapter 5 presents the data collection process, the data analysis and the development of a framework for a decision support tool based on the proposed transport-user satisfaction model.
- Chapter 6 presents the results of the data analyses and the development of the transport-user satisfaction model.
- Chapter 7 presents the testing of the hypotheses and the validation of the transport-user satisfaction model.
- Chapter 8 presents the discussion of the results from the data analysis, and model validation.
- Chapter 9 presents a summary and the conclusion of the thesis.

1.6 CONCLUSION

The thrust of this thesis has been influenced by factors such as accessibility to transport services; the social inclusion agenda of the UK government; the operation of transport in the voluntary sector i.e. community transport; and the paradigm shift to customer-satisfaction in organisational management and activities. The next chapter will discuss the issues pertaining to these factors and relate them to the objective of this work.

CHAPTER 2

STUDY BACKGROUND

2.1 INTRODUCTION

As stated in Chapter 1, the thrust of this thesis has been influenced by factors such as accessibility to transport services, the social inclusion agenda of the UK government, the operation of transport in the voluntary sector i.e. Community Transport (this term is defined in Section 2.3) and the paradigm shift in organisational management and activities. This chapter discusses briefly the issues pertaining to these factors and relates them to the objective of this work. Section 2.2 looks at the issues pertaining to accessibility in transport especially with respect to the needs of people who have one form of impairment or the other, the contribution of transport to social exclusion and the consequent policy by UK governments on transport provision. In Section 2.3, a broad look at community transport operations and their potential as a tool in enhancing social inclusion is taken. Section 2.4 presents, briefly, the current paradigm shift in organisations. Section 2.5 summarises the discussion and some conclusions are drawn in Section 2.6.

2.2 ACCESSIBILITY ISSUES IN TRANSPORT

2.2.1 Accessibility

Accessibility has been defined in several ways each depending on the perspective of the author. (See Wilbanks (1970), Pirie (1979), Tyler (1996), Tyler (2002, p.13), Iwarsson & Stahl (2003)). Accessibility as a word is quite well known, yet no unambiguous definition is available for it because as several authors (e.g. Iwarsson & Stahl (2003)), have shown there are many dimensions and perspectives to it. Dimensions distinguish between accessibility to the physical environment; to information and to activities/services while perspectives range from the objective to the subjective and from the individual to the group perspective. The objective perspective considers that accessibility concerns fulfilling certain measurable requirements such as minimum dimensions for seats; doorways, legroom, maximum distances etc; the subjective perspective argues for the individual user's assessment of the issue (Iwarsson & Stahl (2003)). Lately, accessibility is being looked upon by some as involving an interaction between a person, an activity and the environment (Tyler (2003), Cepolina & Tyler (2004)). In this approach, an attempt is made to incorporate the relationship between the step-by-step demands of an activity and a person's capability with respect to each step, in the conceptualisation of a measure for accessibility. This work is still in an investigative form. An earlier work (Tyler, 1999a) presented the case for proper conceptualisation of the term accessibility to enable its definition, with the view that without this, appropriate measurement techniques cannot be developed.

Accessibility refers to the degree of ease or convenience of using a system whether it is the roadway, an information kiosk, a travel means, a web site, software or a facility entrance. It could refer to the ease of reaching and entering a location as well as the ease of using a service. In this thesis, the definition of accessibility will be as per that given in Tyler (1996) and Tyler (2002, p.13) in which accessibility is defined as 'the ability to be approached, reached or entered'. In this study, the target of accessibility is the transport service. Thus here, accessibility is defined as the ease of reaching and using a transport service (Tyler, 2002 p.13). The ease of reaching (and using) an activity or a service is affected by several factors such as location and time of the activity, the infrastructure design and the individual's physical/mental (dis)ability, income level, car ownership, etc.

The first measures of accessibility concentrated on the location (i.e. distance) factor (Hansen, 1959), as it was relatively easy to compute. The time factor was later included, initially singly and more lately in conjunction as with the development of time-space prisms (see Miller, 1998). The London Borough of Hammersmith and Fulham developed a measure of public transport accessibility, known as PTAL (Public Transport Accessibility Level), which has been adopted by Transport for London and is widely used in London as well as in Surrey. PTAL was developed for linking car use to public transport accessibility in new developments (Marx, 2000) and it helps to describe or establish bands of public transport accessibility based on walking time, actual waiting time, the number of public transport services (including bus, train and tube), and their frequency. It is not a definitive approach but an aid to decision-making usually in land-use planning and development, and increasingly in parking provision planning. PTAL is considered to be a relative measure of accessibility based on access to the public transport network. It measures the amount of public transport available, taking account of the proximity of the stops and stations, the number of services available and the frequency of the services (Marx, 2000). However it does appear that PTAL is more a measure of availability than accessibility because it does not consider the barriers that could prevent a person from reaching or using the public transport. Tyler (2002) also holds this view of the PTAL measure.

London Transport developed a tool called CAPITAL to measure accessibility and social exclusion in London. It measures travel time to a specific destination or from a specific origin, for example a town centre or hospital. It takes into account all the main aspects of journey time i.e. walk access time, waiting time, in-vehicle time and interchange time. It works by combining information from London Transport's Planning and Development Geographical Information System (PDGIS) and its public transport assignment model (RAILPLAN). PDGIS is used to calculate the walk access time to or from the public transport network. The file of the travel times can be fed into the PDGIS and used to create a map showing isochrones of journey times to and from a particular location (L.T. Planning, 1999). These types of approaches enforce only the reaching aspect of accessibility and only utilize the attribute of time.

Most other existing accessibility measure models (see MVA, (1999) for more details on these models) e.g. NAM, ACCMAP, and TRANSAM, also compute accessibility in terms of time – total journey time, travel time, walk time etc. Some others use trip flow e.g. TRAVL devised by the London Research Centre. Utilizing GIS techniques, these models produce accessibility isochrones for networks and for local areas. Some of them e.g. ACCMAP use the PTAL equation. In Europe, there is evidence that attempts have been made in the Province of Gelderland, Netherlands to measure accessibility in terms of the number of people living within certain radius values of bus stops (MVA, 1999). The improvement of time measures over the pure distance measures is that the impact of the speed of the access travel mode can be incorporated in the measure. However, as mentioned previously, these approaches emphasize only the reaching aspect of accessibility.

Attempts to consider the mobility characteristics of the individual with respect to the transport infrastructure design have only recently (relatively) started. These attempts have been due primarily to pressures from disabled peoples rights groups and enactments of government such as the Disability Discrimination Act (HMSO, 1995). So even though accessible transport services are now considered to be beneficial to most people, the original stimulus for their development was due to concerns that disabled and other mobility impaired people had difficulties travelling on the then available transport vehicles and were thus disadvantaged with respect to moving around.

2.2.2 Transport Disadvantaged People

Transport-disadvantaged people are defined in TRB (1999b) as

> "*those people whose range of travel alternatives is limited, especially in the availability of easy-to-use and inexpensive options for trip-making*".

They consist mainly of people who are elderly, disabled (physically, sensorily or cognitively), otherwise mobility impaired or poor (Falcocchio & Cantilli, 1974, p.5). Young people and people without private cars are also considered as transport disadvantaged (TRB, 1999b). Denmark (1996) describes transport-disadvantaged people as

> "*the outsiders who, due to poverty, disability, frailty or other reasons have found their mobility increasingly restricted as the shift to motor car usage continues unabated*".

The transport disadvantaged are also referred to as the mobility deprived (Altshuler 1979, p.303). Battellino and Hensher (1993) also consider the transport disadvantaged to include the elderly, women with young children, people with physical disabilities, low-income earners and those who do not have access to a private vehicle.

Denmark (1996) also reviewed in depth the definitions of the transport disadvantaged group and he indicates that membership of this group is based on characteristics of both the individual and of the environment. These characteristics include permanent or temporary disability (physical, mental, functional, etc); gender (female); age (frail elderly, children, adolescents); geographical location (isolated and/or rural areas); public transport availability (absence, low frequency, unavailable at needed times, etc); occupation (students, unemployed); income (low income households, resource poor people), societal status (migrants, single parents); access to information (socially isolated people and information poor people) and personal encumbrances (feeling of insecurity in public transport, carrying baggage and/or buggies/strollers). Similarly, Battellino and Hensher (1993) hold that people are transport disadvantaged due to not only some inherent personal characteristic, but also to some feature of the transport system on offering.

Transport-disadvantaged people make up about 20% of the UK population (Gillingwater, 1995). In Europe too, some 20% of the population is thought to have a form of reduced mobility as wheel chair users, frail elderly, pregnant women and adults with little children (Aurbach, 2001). Considering that 25% of people over 60yrs tend to have serious mobility impairment (Kreitzman (1996), Health Survey for England (HSE), (2001)) and that the population is ageing rapidly – in the UK for instance, people over 65yrs made up 16% of the population in 2002 (National Statistics (2003, Table 1.4)), and that this proportion is estimated to reach 19% by 2021AD (National Statistics (2003, Table 1.2), Age Concern (1999)) and 25% by 2041AD (Age Concern, 1999) – it is expected that the percentage of mobility impaired people in society will also increase.

From The Chambers Dictionary (1998), impairment is defined as a condition of a reduction in strength, value or quality. Thus mobility-impaired people are people whose mobility i.e. ability to move has been reduced for some reason. Impairment to mobility is quite varied both in type and duration. People could have a permanent impairment like paralysis or amputation which makes them wheel-chair dependent or a temporary one e.g. having to use crutches for a week to support a sprained ankle. Impairment types involve visual, auditory, locomotory organs and mobility encumbrances due to luggage, shopping bags or a child's buggy. Finance or the lack of it can also cause impairment as it can prevent people from making journeys they would otherwise wish to make.

The wide range of impairment types and duration implies a very wide range of transport user abilities and needs. A balanced community should offer a range of modes of transport, including public transport, which allows communication and access to a range of facilities for all people irrespective of their abilities. This responsibility is recognised in the 5th Standard Rule on the Equalization of Opportunities for Persons with Disabilities as prescribed by the United Nations (UN, 1993):

> *"States should recognize the overall importance of accessibility in the process of equalization of opportunities in all spheres of society".*

Where appropriate transport is lacking, the individual's ability to partake in everyday activities could be hampered. The restriction in the ability to reach work, health care, educational centres, shopping and leisure/entertainment facilities exacerbate the situation currently described as social exclusion. SEU (2003) states in its summary that poor transport contributes to social exclusion primarily by restricting access to activities that enhance people's life chances, such as work, learning, health care, food shopping, and other key activities.

2.2.3 Social Exclusion

The term social exclusion is relatively new in the British policy debate. Social exclusion has been defined as

> *'a shorthand term for what can happen when people or areas suffer from a combination of linked problems such as unemployment, poor skills, low incomes, poor housing, high crime, bad health and family breakdown'.* (SEU, 2001)

SEU (2001) asserts that the problems listed are only examples and that other dimensions of exclusion could be added. It also states that

> *'Social exclusion is something that can happen to anyone. But some people are significantly more at risk than others. Research has found that people with certain backgrounds and experiences are disproportionately*

likely to suffer social exclusion. The key risk factors include: low income; family conflict; being in care; school problems; being an ex-prisoner; being from an ethnic minority; living in a deprived neighbourhood in urban and rural areas; mental health problems, age and disability.' (SEU, 2001)

Social inclusion as a term is a response to the issues of social exclusion. The Centre for Economic & Social Inclusion (CESI, 2002) has defined it as *'the process by which efforts are made to ensure that everyone, regardless of their experiences and circumstances can achieve their potential in life'*. Before proffering this definition, CESI (2002) reviewed definitions of social inclusion developed by other bodies in UK, Europe and worldwide. Some of the definitions are reproduced below:

- *'Social inclusion is achieved when individuals or areas do not suffer from the negative effects of unemployment, poor skills, low income, poor housing, crime, bad health, family problems, limited access to services and rurality, e.g. remoteness, sparsity, isolation and high costs.'- (UK Government)*

- *Social inclusion is the term used to describe the process by which efforts are made to ensure that everyone, regardless of their background, experiences and circumstances, can gain access to the services and facilities they need to achieve their own potential in life.' (Edinburgh Youth Social Inclusion Partnership, UK)*

- *'Social inclusion is to be achieved by involving the poorest of citizens so that they experience a rise in living standards, from which they are excluded at present due to a host of interrelated problems.' (Lancashire County Council, UK)*

- *'The development of capacity and opportunity to play a full role, not only in economic terms, but also in social, psychological and political terms.'- (European Social Fund, EU)*

- *'An inclusive society must be based on respect for all human rights and fundamental freedoms, cultural and religious diversity, social justice and the special needs of vulnerable and disadvantaged groups, democratic participation and the rule of law.' (United Nations)*

- *'Social inclusion is not only reflected in the material living condition (for example, income and housing conditions) but also, and moreover, as a subjective element: self-esteem and the feeling to belong to a community are important elements of this subjective dimension. A concrete example is the satisfaction of developing one's own business or a cooperative, not to be walking anymore in the mud, to have an address (and to be able to receive a phone bill or correspondence from friends).' (Mayor of Santo André, Brazil)*

Thus social inclusion has to do with enabling people to play a full role in society. For people to participate fully in society they need to be able to move around easily. With the present day phenomenon of large cities, many activity centres are not within walking distance and so people have to use mechanised means of movement. This means of movement could be by private or public owned transport. For many transport-disadvantaged people, the current public transport provision is often inadequate for their needs. When and where the gap between the individual transport user's needs and the available transport provision is too large, the user will not use the transport service and would then have to forego making some trips which may otherwise have been beneficial to his or her well-being. It is perhaps not coincidental that four of the identified risk factors for social exclusion (low income; mental health problems, age and disability.) apply to transport disadvantaged people.

People living in communities repeatedly highlight transport as a significant factor in enabling them to access services and lead less excluded lives (Age Concern, 1999). Age Concern (1999) states that transport is particularly important to older people and others on low incomes or without access to a car. Currently, older people are less likely to have access to a car than younger people. The General Household Survey of

1994 found that 64% of men over 65 and only 41% of women over 65 have access to a car. 49% of all older people did not have access to a car and likewise 78% of all older people who lived alone (Office of Population Censuses and Surveys (OPCS), 1996). [The General Household Survey for 2000/2001 did not update these figures]. This reported gender disparity in access to cars may be due to the prevalent cultural influences at the period when these elderly people were younger, in which females were more likely not to drive or even know how to drive. It is expected that for the present and future generations of elderly people, this disparity would not be so pronounced. The 'Car Use in GB' factsheet produced by the Department for Transport (DfT, 2003) indicate that the gender disparity for driving licence ownership is narrowing as age reduces. That is, for the age group 60-69 years, the male:female licence ownership ratio is 86%:57%; while it is 41%:31% for the age group 17-20 years. Thus it is expected that the gender disparity at retirement age will be reduced when the younger age group reach that age.

A survey by Kreitzman (1996) points out that only 17% of those currently aged between 17 and 60 live in households without access to a car and concludes that a substantial rise in car use in later life is likely. Presently, car travel accounts for four fifths of the total distance travelled per person and for 63%of all trips made in 1999/2001 (DfT, 2003). In 1999/2001, the main reasons for a car trip were for shopping (20%), commuting (17%), and visiting friends (15%) (DfT, 2003). Dependence on the private car has both encouraged and been encouraged by the dispersion of activity centres especially for shops and recreation.

The pattern of dispersed activity centres has contributed to the inability of public transport services to cater adequately for the travel needs of people. Schlag et al (1996) conclude

> *'The inadequate provision of public transport constitutes an objective barrier to mobility of people without a car.'*

This population is not minute as can be deduced from the following statement from the SEU (2003. Summary, para. 15):

> *'nearly one in three households do not have access to a car'.*

The research by Schlag et al (1996) also concluded that

> *'mobility is of great importance to older people; adequate mobility is related to greater life satisfaction and is an important contributor to perceived quality of life'.*

Restriction in mobility or the ability to move around affects both the young and elderly and the able and disabled. In addition to quality of life being adversely affected, for younger and more able-bodied people, employment and education/training opportunities are also adversely affected (SEU, 2002).

The social exclusion phenomenon is such that it creates and enhances its own problems: e.g. due to low income, an individual cannot travel to look for jobs and so because they cannot work, they remain poor. For society, an effect of social exclusion such as continual sectional poverty is an ill that no government can afford to ignore as it can lead to a rise in crime levels and neighbourhood decline.

2.2.4 Government and Social Inclusion

The UK Government set out to tackle the problems of social exclusion by setting up the Social Exclusion Unit in the Cabinet Office to explore and make recommendations to overcome the problems experienced by people facing social exclusion in reaching work and key services such as health and education. The Government has worked with its partners to tackle social exclusion through the work of many Departments and the Social Exclusion Unit. It has identified three key objectives to all this work: preventing those at special risk (i.e. possessing more of the risk factors identified in Section 2.2.3) from becoming excluded, reintegrating those who have become excluded and improvement of basic service standards so that they are more inclusive.

SEU (2002) findings indicate that though poor transport is just one of a number of contributors to social exclusion and many people experiencing social exclusion will not suffer from poor transport, poor transport can nevertheless be an important factor in restricting access to opportunity. By restricting access to opportunity, key government objectives on welfare to work, raising educational achievement and narrowing health inequalities would be undermined as the people government would have targeted to impact through these schemes would not participate in the schemes and thus would not receive the intended benefits. Such occurrences would cost not the state, but also individuals, businesses and communities.

In its attempt to promote social inclusion, therefore, the government is currently placing a lot of emphasis on efforts to make suitable transport services available to the transport-disadvantaged people in the society. Providing accessible transport is a major target for the government and it has thus made accessibility a condition for public funding of transport schemes (DETR, 2000a). Recognising the inability of conventional public transport to provide effective service in times and areas of low transport demand, UK government is putting efforts into encouraging and supporting non-conventional transport modes in the voluntary sector and public sector.

These non-conventional modes include paratransit and specialised transport in the voluntary sector such as community buses, door-to-door, and social car schemes; and in the public sector such as school buses, outpatient ambulance service, hospital car service and social services transport (Sutton, 1988). However, some door-to-door schemes such as the Dial-A-Ride in London are in the public sector. Government considers that providing such specialised transport helps in meeting the objectives of its policy on social inclusion (DETR, 1998). In the recent report by the Social Exclusion Unit of the Cabinet Office, SEU (2002), specialized transport is considered necessary to achieve the objective of improved social inclusion. The report recommends changes to enhance

> *'specific transport for pupils, patients, social service clients and jobseekers'* (Page 5, Sec. 21).

In the UK, the modes in the voluntary sector are often collectively referred to as Community Transport (Sutton & Gillingwater, 1995). When compared with the public sector modes, they have fewer restrictions on possible users (i.e. the eligibility criteria they employ is less stringent than that employed by the public sector modes such as school buses, outpatient ambulance service, hospital car service and social services transport). For example, to qualify to use the outpatient ambulance service, a person must have a medical personnel's recommendation of being medically unfit to travel by other means (Bailey & Layzell, 1983, p. 10). Likewise for certain social services transport, a person needs to have a care-worker's assessment that he or she requires such transport. Generally the public sector services not only have eligibility criteria for users, they also have limitations on where they can go. Some can only be used to make trips to hospitals, or schools or day centres. With these types of conditions, it is very likely that quite a number of people will not be eligible for these services and even for those eligible, other trips such as shopping, recreation or even visiting relatives cannot be made if alternative suitable transport does not exist.

A report produced for the Department of Environment, Transport and the Regions (DETR, 2000b) states

> "*Community Transport covers the transport needs arising from the issues of gender, ethnicity, young people isolation, poverty and people on low income, as well as older and mobility impaired people*".

Denmark (1996) also states that community transport has the potential to address common forms of transport disadvantage. John Hyde's view (Hyde 1985, p.10) of over fifteen years ago is still very relevant today. He holds that the planning functions and the operational functions relevant to transport provision come together in a community transport setting, thus making the services that are provided much more relevant and useful to people than other traditional public transport forms. He also holds that the decentralisation of community transport planning and control, unlike traditional transport planning, enables specific targeting of services to the needs of a particular geographic area. Thus, community transport has the potential to be more flexible in responding to specific needs than conventional public transport.

In some countries, such as Australia, where community transport has developed a broad passenger base and continues to provide a range of services that fulfil disparate transport needs, the need and demand for community transport remains (Battellino and Hensher, 1993). There is already a high level of awareness of community transport among respondents of all age groups in a transport survey in the UK by Help the Aged (1998a). The survey report supports the view that Community Transport has the potential to address the needs of a wider range of users than traditionally thought. Traditionally, Community Transport has been considered to be for the elderly and/or disabled groups of people. However, this need not be. Community Transport, as some of the studies reviewed have indicated, is relevant to the transport needs of other people within the transport-disadvantaged group.

Community Transport is thus, potentially, a more versatile tool in the government's programme for social inclusion and therefore it will be looked at in more detail in the next section.

2.3 COMMUNITY TRANSPORT

2.3.1 Community Transport - Origin and Operations

The fixed nature of mainstream bus routes, often seemingly based on financial viability and convenience to the operator rather than the range of people's needs, coupled with the unreliability of many services mean that transport services for people living in suburbs or on peripheral estates are limited. There is a need for improvement in both access to public transport, and to public transport services, and for innovative ways of making public transport more flexible and accessible. Voluntary transport has been and is being used to meet the needs of trip makers especially in situations of spatially and temporally diffused transport demands [see Gillingwater and Sutton (Eds.), (1995) and Bailey and Layzell (1983) p.21].

Community Transport, which is a type of voluntary transport and has played an important role in this respect, has been defined as

> '*a response to the transport needs of individuals or groups not met by private, statutory or conventional public transport services*' (DETR, 1999a, Sec. 2.7).

Battellino and Hensher (1993) state that Community Transport projects evolved in order to provide service for transport disadvantaged people, and that most Community Transport projects grow out of local initiatives and offer services within a very limited budget framework in a way that it considers meets the transport needs of the local transport-disadvantaged population.

The ethos of Community Transport operations has been to meet as much as possible the varied needs of the different users. Thus its customer-centred approach differentiates it from other conventional transport operation types where the major objective appears to be to keep the system running to schedule even at the expense of the customer. For example, mainstream bus drivers leaving a bus stop as scheduled even though there is a passenger running up to catch the bus. Community Transport is also characterised by its non-profit nature, its relevance to people's needs and the mechanisms that allow community input into its management (Denmark, 1996). This focus on passengers' needs gives Community Transport a credibility that its relatively small share of the transport market would not otherwise allow (Denmark, 1996). Community Transport operators currently aim to provide transport for those people excluded from public and even private transport by reason of age, income and/or disability and other groups such as women and families with very young children.

In the UK, Community Transport operations first started in Birmingham in 1966. Since then, the numbers of such schemes have increased to about a thousand in 1990 (Sutton & Gillingwater, 1995) and about 5000 in 1999 (DETR, 1999a). As the numbers of Community Transport operations increased, duplication of services and resources began to occur as different organisations purchased and operated their own vehicles. Different organizations provided parallel and often similar services. People and areas served overlapped and a lot of vehicles had considerable down times as they were for the use of only specific groups. Studies such as USDoT (1980), Bryman, A., *et al* (1995) and L.B. of L&S (2001) conducted to investigate the operations of Community Transport confirmed this and advocated the need for coordination of these operations for improved service to users, efficiency, cost-effectiveness and higher vehicle utilization. For an effective urban transportation system, Vuchic (1981, p.609) advocates for a brokerage form of coordination that includes paratransit-type services.

Studies (e.g. Bryman *et al*, 1995 and Rosenbloom, 1981) have shown that the benefits when community transport groups work together in some form of coordination include increased utilization of resources and improved quality of service to users. Coordination can range from brokerage to consolidation. Brokerage involves several levels of operation including when a central agency contracts out trips to independent transport operators i.e. acting as middleman between the demand and the supply; and when a central agency manages vehicles owned by itself and/or by other parties to provide transport service to different groups or individuals (Rosenbloom & Warren, 1980). Consolidation requires a pooling together of vehicles, staff and operations under one management. In the UK, several Transport Coordination Centres (TCC) exist with varying levels of "coordination".

2.3.2 Community Transport Coordination

Coordination can be defined as the arrangement and combination of transport services for statutory and/or voluntary sectors. It can be of very different forms, ranging from vehicle sharing to integration of management and services to total consolidation i.e. amalgamation of management and services. In an attempt to determine what form of coordination would be best for community transport in London, Transport Committee for London (TCfL, 2000), commissioned several pilot coordination schemes in selected borough councils in London. Each scheme was to test out a different form of coordination of operations. The schemes are defined as follows:

1. The integration of provision of social service, education, Patient Transport Service and Dial-a-Ride services through a single integrated provider with an integrated vehicle fleet and workforce;
2. The integration of provision of social service, education, Patient Transport Service and "taxicard" services through a single integrated commissioner (a "demand centre") using a number of contractors including taxi and minicab operators;
3. The provision of an integrated public door-to-door service replacing separate Dial-a-Ride and Taxicard schemes, and using both buses and taxis.

The first scheme is an example of consolidation of operations while the other two are forms of the brokerage system of coordination but with differences in the range of transport operation types from which service can be obtained. The outcome of these pilot schemes is yet to be published by the Transport Committee for London (now part of the Association of London Government, ALG). However a draft report was expected by late Spring 2004.

A Community Transport scheme run at the London Borough of Hackney employs a brokerage form of coordination where a transport manager procures transport services from a pool of registered independent operators to meet the transport needs and requests of clients of providers such as the Social Services Department (Tyler, 1999b). This form of coordination, in which vehicles are owned and run by independent operators, and services are only purchased, frees the social service providers and/or the trip purchasers from the burden of managing vehicles and drivers with the attendant implications of administrative costs and staff wages even when vehicles are not in use. It also provides a wider range of choices for the broker to make a selection from, in meeting the specifications of a travel request.

Because of this wider range of modal and vehicular choices, this form of coordination appears to have great potential for extension of service to members of the public other than the clients of the established government providers/purchasers. This is because the transport supply would be varied enough to meet the different needs of the wide spectrum of ages, mobility levels, income levels, gender and trip purposes present in the population and also because the broker with a knowledge of all possible options will be able to select the most appropriate service for the travel request.

2.3.3 Transport Brokerage Decision Making

Community Transport operations involve receiving and booking requests for trips from individuals or groups either directly or through their providers/carers and then considering and assigning these requests to appropriate vehicles and schedules. In settings where the fleet consists of identical vehicles, trips are just scheduled and the next available vehicle used, but in brokerages where different vehicular types exist, selection of appropriate vehicle is done during the booking process. Currently, the main criteria in booking systems, both manual and computerised, are vehicle availability, costs and time constraints, and matching passenger disability and vehicle capability {Davies (1987), Stone et al (1993), Bennett (1995) and TCC (2001)}.

Figure 2.1 below attempts a schematic representation of the current model of a brokerage vehicle selection process. Typically, the first considerations are of the availability of the vehicle in both spatial and temporal frames, and the cost of providing the vehicle. Then a consideration is made of the suitability of the available vehicle (and crew) for the particular mobility requirements of the client. The output from these considerations informs the choice of vehicle that is provided to meet that client's request.

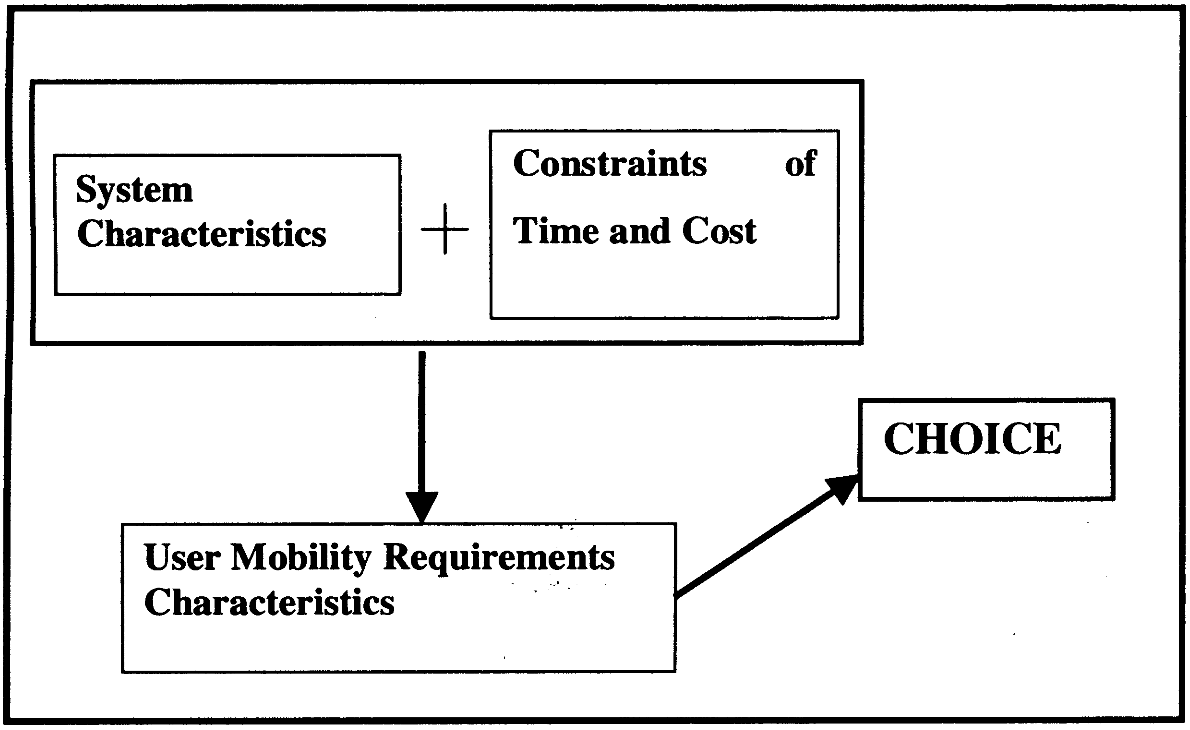


Figure 2.1 Current Vehicle Selection Process Model

While matching passenger disability and vehicle capability might address the issues of physical and sensory accessibility, issues pertaining to a user's preferences on the more qualitative travel attributes and to satisfaction are not addressed even though qualitative travel attributes have been seen in surveys to be very important to transport users. [See DETR, (2001), Help the Aged (1998a,b)]. A number of factors do impact on the satisfaction experience that a user receives on using a service. The levels of performance of the transport alternatives in these factors and the users' preferences for each of them need to be considered when transport is being chosen.

To make this kind of consideration systematically for a large number of important and relevant travel factors in transport provision will be quite difficult without a decision support tool. This would be compounded by the possibility that different clients would consider different attributes relevant. However, such a consideration is important especially in the present consumerist climate of choice and where people are used to being offered goods and/or services tailored to their order by companies operating in a competitive environment. This is a major shift from a focus on organisational structure to one on customer satisfaction and it will be discussed in the next section.

2.4 PARADIGM SHIFT

Kuhn (1996) uses the term paradigm, which means 'one that serves as a pattern or model' to describe achievements in the sciences that provide models from which scientific research traditions spring. The term has been used in the sciences to refer to a theoretical framework. Such a framework can be considered as a set of assumptions, concepts, values and practices that constitutes a way of viewing reality in that particular discipline. Across organisations, the way goods and services are evaluated is changing significantly. There is increasingly a shift towards customer-oriented services and goods in most organisations. Issues such as accessibility and qualitative attributes of travel are emerging as being critical to transport users, yet the perspective of the individual customer has generally been ignored in the transport sector. There is a growing realisation that there is a need for a paradigm change in the transport industry (Sussman, 2000, p.107). This change is essentially a shift from managing transport assets to managing transport services.

The change from an industrial world to an information technology world has resulted in a shift of emphasis from "operational efficiency, focus on one piece, command & control, autonomy & adversarial and machines, buildings & materials" to "flexibility & adaptation, focus on whole system, collaboration, employee involvement & empowerment and information & people" (TRB 2000, p. 2). The new information age is enabling businesses to tailor goods and services to the individualised customer needs and build partnerships and collaborations with former competitors to deliver. It is also enabling more middlemen or broker types of businesses – linking clients and suppliers. Essentially, the objective of a shift in paradigm now, will be to increase transport options by

> *"better aligning resources, decision-making processes, and service delivery with customer needs, travel markets and broader community goals."* TRB (2000, p. ii).

TRB (2000) also states on page 14:

> *"Increasingly in other businesses and industries, however, the paradigm of production efficiency and "the bottom line" is being balanced with the addition of a new measurement paradigm based on customer satisfaction, value, and loyalty. Inability to understand and respond quickly and effectively to customers and markets are hallmarks of industries in decline. To be successful in the future, public transportation organizations must follow the lead of other organizations that have used a heightened commitment to customer service to drive fundamental change in business processes and organizational structure. Much of this progress has involved the use of assets owned and operated by former competitors rather than forcing customers to choose between competing services. New information technologies can provide the critical link between allied service providers and customers".*

Previously, performance measures for organisations used to be related to service or good production efficiency. But the new paradigm shift proposes and uses performance measures related to the experience of the customer. These two types of performance measures are quite distinct. But both are important and appropriate at different scales.

While it is acknowledged that a few researchers (see Bauman, 2001; p. 130-133) are concerned with the ultimate end of a society run on the concept of the consumer as king, fearing an ultimate loss of perspective, it must be accepted that this 'King Consumer' concept currently determines the market trends. Such researchers believe that a consumerist concept approach to service provision is unsustainable. There is a sense of there being a limit to which services can be stretched and/or adjusted to meet varying customer needs/preferences. However, it can be argued that such fears are unfounded. This is because business and services respond to patronage. So as long as the customer is "buying", the producer would keep providing what the customer wants. The whole concept of customer satisfaction is not really philanthropic but rather profit-dictated. Businesses and service providers give consumers what they want because they are more likely to buy what they really want than just anything available. The necessity of such an approach in transport is obvious. People are not using much of the provided transport because it does not meet their needs and/or preferences. For transport to be utilised maximally, it must meet the needs and preferences of the users.

Thus the shift towards customer satisfaction as organisational priority should not, and indeed cannot, be restrained. Over the last decade, the major reforms taking place in the private sector manufacturing have included total quality management (TQM) which has as the first of its seven basic principles this: 'Put Customer First' - MacDorman et al (1994). TQM is a comprehensive and long-term transformation of the culture of the organization, focusing on people first — including passengers, employees, and the community. In addition to customer-orientation, this new paradigm encourages collaboration between former competitors, as door-to-door service utilising the infrastructure of others becomes necessary in attempts to provide the user with a seemingly seamless service. Such collaboration is a key part of the coordination of operations and services in the community transport sector that has been recommended for effectiveness in that sector. Thus the suggested paradigm shift is already being evidenced in the community transport sector, which is not surprising considering the original ethos of that sector is user-centred.

2.5 DISCUSSION

Accessibility, which relates to the ease of reaching and using a service, is a key issue in the planning and provision of transport both in the UK, and in North America and Europe. Transport operators and providers, in compliance with government policies, have done much work to make transport vehicles, information and access to transport facilities more physically accessible. For instance, in terms of reaching services, routes to transport termini have been improved with tactile pavements, lifts, etc. Currently the focus within the usage aspect of accessibility has been on the physical, sensory and cognitive abilities of users. Improvements have mainly included: physical – wheelchair space, wide entrance, low floor, etc, cognitive – clear maps, timetables, etc and sensory – audio announcements on station/stop arrival, doors opening and/or shutting, etc.

However, transport users do have needs and preferences [Help the Aged (1998b), DETR (2001)] beyond disability requirements, for characteristics of travel such as safety, comfort, convenience, friendly crew, reliability, ease of entrance and exit, etc., that can affect their satisfaction with the service provided and thus their usage of the service and consequently, affect their quality of life. Surveys of transport disadvantaged groups such as elderly, disabled and young people indicate that among the transport needs they profess to have, travel characteristics such as comfort, security and convenience rank high [DETR, (2001), Help the Aged (1998a,b)]. These qualitative travel characteristics have been found by the following authors [Bindhu & Sathikumar (2001), Spear (1976), Nicolaidis (1975) and Kobayashi et al (1975)] to play an important role in the average traveller's decision, particularly in the choice of travel mode and including them in mode choice modelling process has been found to improve the goodness-of-fit of the models (Spear, 1976).

If these attributes are not adequately provided for by the transport services, user satisfaction can be expected to be low and likewise usage of the services provided would be low. If the transport services painstakingly adapted to meet physical and sensory accessibility requirements are not being used, then it cannot be said that improvement in access to transportation for disadvantaged groups has been achieved. Neither therefore can social inclusion be said to have been achieved for these groups. Thus while improving the physical accessibility of transport is a necessary component of any solution to transport related social exclusion, it is not sufficient. An acceptance of the service by the user as meeting his or her needs and desires is also required to ensure usage of the service and thus a reduction in social exclusion. This acceptance can be likened to a sense of fulfilment from the service, in other words, satisfaction with the service.

A basic assumption behind the provision of accessible transport is that transport users are a captive market and that they will use the service as a matter of course. Thus when there is low usage of a service, it is assumed that demand for the service has fallen whereas it is actually more an indication of poor access to the service and inappropriate routes than a lack of demand (Stone, 1985, p.149 & 151). Church et al (2000) concludes that increasing access to activities and services requires combating the individual's constraints at either end of his or her journey in addition to increasing transport system availability and performance. These constraints in the context of social exclusion can involve attitudinal as well as physical and financial factors. Supposing the user does not enjoy using a service and so declines to use it. What this means will differ for different groups of people. For the elderly and the disabled, mobility will be reduced and hence their quality of life and perhaps even their health (see Metz, 2000). The implications for health care costs can be expected to be high. For able-bodied people with mobility encumbrances such as baggage, poor finances and/or accompanied young children, mobility will also be affected and social exclusion increased. For more enabled people, with the financial means, there will be recourse to private transport or other more expensive (and satisfying) modes. Such moves would impair efforts to encourage use of public transport and reduce private cars on the roads.

Approaching, reaching and then using a service come after deciding to use the service. The decision to use a service is based on a choice process. In transport, modal choice is strongly influenced by attitudes towards modal attributes as well as the system performance on the attributes. Thus accessibility, in addition to the basic and common factors related to location distance, time and system performance, should incorporate users' perceptions of the system's performance. Unfortunately, in providing accessible transport, not much consideration has been given to incorporating users' perceptions in the decision-making process or even to modelling attitudinal issues such as passenger satisfaction even though attitude has been shown to have a strong influence on intention and behaviour, and thus usage of services. Studies in the service industry show that customer loyalty and re-purchase are positively related to customer satisfaction (Anderson et al, 1994; Ittner & Larcker, 1998; and Costabile, 2000). Thus satisfaction can be considered to have a strong influence on the decision of an individual to re-use a service. Battellino and Hensher (1993) also agree that designing transport services with users' needs in mind, rather than putting service patterns in place and expecting the travelling public to design their transport needs around them, can be advantageous to the operator, by generating increased patronage and revenue and to the travelling public by increasing the accessibility of services.

Perhaps, this shortcoming in the decision making process is due to the fact that the consideration of users' preferences towards abstract transport characteristics in decision-making is not a trivial task. It is a multi-criteria decision problem for which presently no tool seems to exist. The lack of a tool by which these factors can be systematically considered in the planning and provision of transport makes it difficult for transport managers and operators to add user qualitative preferences to their transport selection and provision criteria. This is particularly true in community transport brokerage operations where there can exist a variety of vehicular types available for selection to meet any transport request. What is needed here is a consistent and objective tool by which several travel options can be compared for customer satisfaction so that the most satisfying service can be provided for a client. This comparison requires that such a tool incorporate an algorithm capable of predicting the satisfaction a user would receive on using a transport option.

There is therefore a need to consider satisfaction issues in transport, i.e. issues that influence transport users' enjoyment of the service, and develop means of using satisfaction as a criterion in transport provision. The current paradigm shift resulting in increased emphasis on customer satisfaction emphasizes this need. There is a lot the transport industry can learn from other industries and businesses in this respect. One of the lessons to be learnt is that in this present information technology age, the customer is very important and his or her loyalty is dependent on how well their satisfaction needs are met by the service or good. Ability to cater to individual needs is also very important. Transport organisations have generally considered themselves primarily as asset managers rather than as service providers to an important (and influential) market. But service provision is more than ensuring punctuality and/or maintaining vehicles. As well as overall system performance, it should cater for customer satisfaction. In line with the paradigm, both system performance and customer satisfaction should jointly make up the overall performance measure for the organisation.

In Figure 2.2, a proposed model for a brokerage vehicle selection process is schematically presented. In the proposed model, the first consideration should be of the user's characteristics (hence requirements) and preferences. This should form the primary selection criterion before consideration is made of the spatial and temporal availability of the vehicle, and its provision cost. This way, when a suitable vehicle based on the user's primary criterion can not be found within the available fleet, even if a less than suitable vehicle is eventually used, there is an awareness that the fleet as presently constituted falls short for a (or some) customer(s). Arrangements can then be made to improve the vehicles and/or the service levels or even purchase more suitable vehicles.

Comparing Figure 2.2 with Figure 2.1, this proposed model improves on the current model by presenting a process where there is provision for the consideration of the satisfaction-related preferences of the customer or transport user at the first stages of the vehicle selection process.

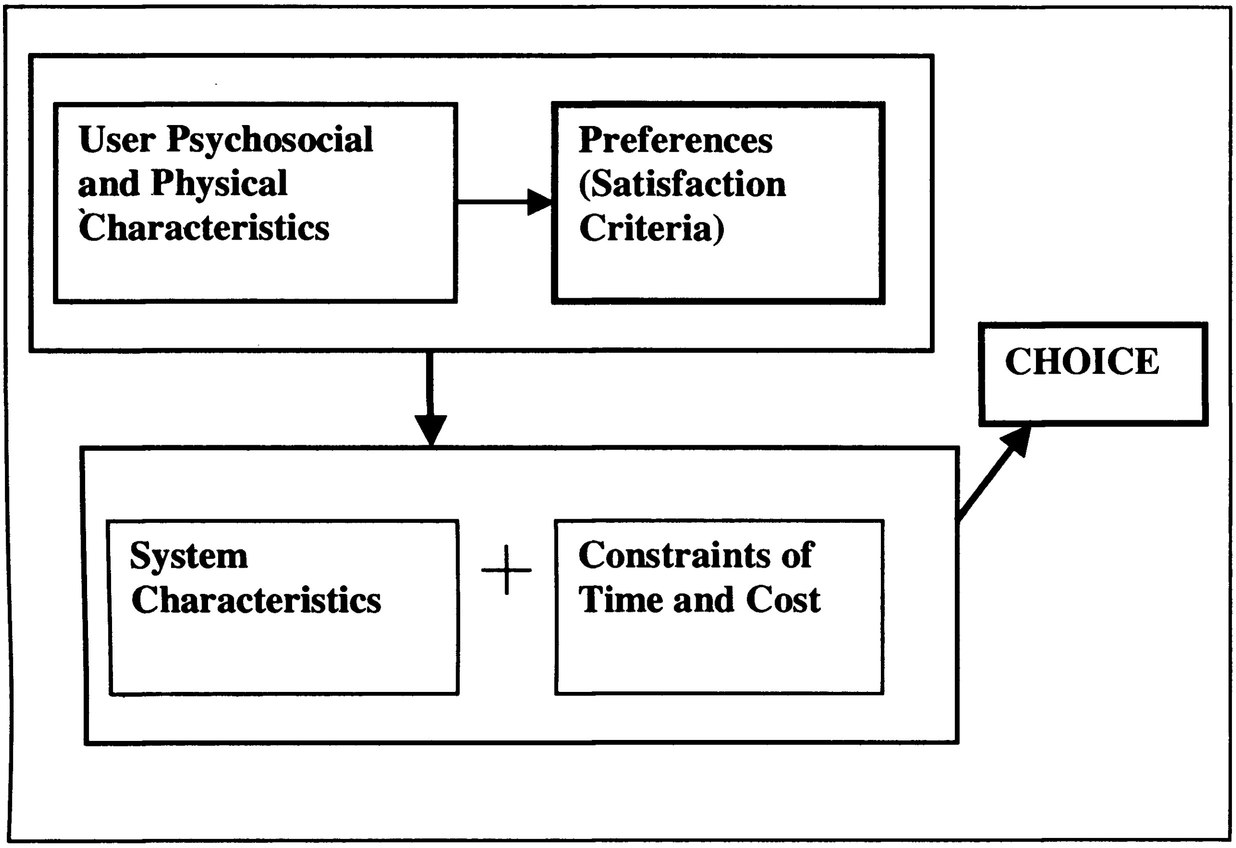


Figure 2.2 Proposed Vehicle Selection Process Model

2.6 CONCLUSION

This chapter has looked at the issues that have influenced this study and concludes that there is a need to include user satisfaction in vehicle/transport selection criteria and thus develop a decision support tool, incorporating user preferences, by which different services can be assessed for the individual. The next chapter will attempt to look in depth at the concept of satisfaction, its formation process as well as its influencing factors in transport and how a predictive model of it can be developed.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 INTRODUCTION

In the previous chapter, it was concluded that there is a need to include user (i.e. consumer) satisfaction in vehicle/transport selection criteria and develop a decision support tool, incorporating user preferences, by which different services could be assessed for the individual. This requires the development of a model capable of predicting a user's satisfaction level for a transport option as part of the decision support tool. Such a tool is suitable for use in a transport brokerage setting, where a variety of transport services and vehicle types are available.

For this model, it is necessary to determine the factors influencing user or consumer satisfaction in transport services. People will differ in terms of their preference order for such factors, thus no single transport service can be optimal for all people. Therefore the model to be developed needs to be defined at the individual level. The assumption is that if individuals were satisfied with the transport service provided for them, then they would choose to use it again when the opportunity arises. With increased usage, accessibility can be said to have increased and thus social inclusion would have been improved.

This chapter reviews the literature on the issues relevant to the development of such a model. Section 3.2 reviews the literature on satisfaction, looking at the concept and its definition, the models that have been proposed and tested to explain the satisfaction formation process and the application of such models to the transport satisfaction formation process. In Section 3.3, the factors affecting transport satisfaction are reviewed, an adaptation of the general customer satisfaction model to fit the transport situation is considered and a transport-user satisfaction prediction model is proposed. Hypotheses relevant to the testing of the proposed model are also formulated in Section 3.3 and the chapter is concluded in Section 3.4.

3.2 SATISFACTION

3.2.1 Concept and Definition

3.2.1.1 Concept

The concept of consumer (or customer) satisfaction / dissatisfaction (CS/D) has received considerable attention in the marketing and consumer behaviour literature (Cadotte et al. 1987, Oliver and Swan 1989, Rogers et al. 1992, etc). Since the study by Cardozo (1965) on customer efforts, expectations and satisfaction, the number of studies in the field has increased phenomenally. A compilation of the bibliography for the field (Perkins 1991) indicated more than 900 publications in the field for the period 1982-1990 and by the next update two years later, (Perkins 1993), 1700 new entries were made. (Note that the terms 'customer' and 'consumer' are used interchangeably in the literature and this pattern is also adopted in this thesis).

Consumer satisfaction has been a concern because of the belief that, in the long run, satisfied customers are critical to the successful practice of marketing and to the overall profitability of an organization. This is because customer satisfaction with a service or product often leads to repeat purchase and favourable word-of-mouth which is a positive contribution to advertising efforts. In saturated markets, customer satisfaction is thought to be one of the most valuable assets of a firm. Another reason for the concern with consumer satisfaction is because of the many negative effects that can result from consumer dissatisfaction (Richins 1983; Engel and Blackwell 1982). Satisfaction is also important to the individual customer as it indicates a positive outcome from the use of his/her scarce resources and/or the fulfilment of needs.

Satisfaction, unlike choice, is a post-consumption phenomenon i.e. it occurs after the purchase (and consumption) of a product or service. Satisfaction could be considered with respect to a specific transaction or to a cumulative experience of the service. It could also be considered with respect to an evaluation of the overall service or to an aspect (attribute or dimension) of the service. Satisfaction also differs from service quality, which is an assessment of the overall excellence or superiority of the service (Zeithaml, 1988). Service quality involves asking 'How good is/was this service?' while customer satisfaction involves asking 'How well does/did this service meet your needs'. Unfortunately, several studies have treated quality and satisfaction as synonymous (see de Ruyter et al, 1997 which lists studies that argue for their inter-changeability based on the premise that both constructs are dependent on the same antecedents). However studies such as Cronin & Taylor (1992), Oliver (1994) and de Ruyter et al (1997) have yielded results suggesting that satisfaction is a different concept from service quality. Oliver (1994) and de Ruyter et al (1997) go on to conclude from their results that satisfaction is a super-ordinate concept to service quality and that satisfaction is dependent on service quality.

3.2.1.2 Definition

Satisfaction is defined in The New Choice English Dictionary (1999) as the fulfilment or gratification of a desire, need, or appetite. As a psychological construct, however, satisfaction has had different authors proposing different definitions for it. These definitions attempt to define the key concepts of satisfaction and the mechanisms by which the concepts interact.

(Oliver 1997, p.12) lists the following definitions from some authors:

- *"[A]n Evaluation that the {consumption} experience was at least as good as it was supposed to be"*
- *"[T]he summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience"*
- *"[T]he consumer's response to the evaluation of the perceived discrepancy between prior expectations {or some other norm of performance} and the actual performance of the product as perceived after its consumption"*

He then goes on to offer the following definition:

- *"Satisfaction is the consumer's fulfilment response. It is a judgement that a product or service feature, or the product or service itself, provided (or is providing) a pleasurable level of consumption-related fulfilment, including levels of under- or over-fulfilment."* (Oliver 1997, p.13).

Johnson and Fornell (1991) define satisfaction as

- *"a psychological concept arising from an individual's comparison of perceived product performance with his expectations for the performance."*

Some other definitions include:

- *"Consumer satisfaction will be define[d] as a post-consumption evaluative judgement concerning a specific product or service."* (Markovic and Horvat, 1999).
- *" ... consumer satisfaction/dissatisfaction may be thought of as the cognitive state of being adequately or inadequately rewarded in a buying situation for the sacrifice he (the buyer) has undergone."* (Gronhaug, 1977).

The above definitions recognize satisfaction as a judgement - the outcome of a psychological process, however, the descriptions of satisfaction vary between "evaluation", "response to evaluation", "summary state" and "cognitive state". While most of these definitions refer to satisfaction as the outcome of the judgement or evaluation process, in the third definition, for example, it is referred to as the response to the judgement. This supposes a two-step activity in which the consumer first evaluates the experience and then decides whether he or she is happy with it or not. It appears that the other authors consider that these activities are not as differentiated as that and that the response is incorporated in the comparative evaluation through the standards used in the comparison.

Giese and Cote (2000), in their in-depth study on defining consumer satisfaction, observed that the *"literature is replete with different conceptual and operational definitions of consumer satisfaction"*.

They note that the lack of a consensus definition for satisfaction creates three serious problems for consumer satisfaction research – selecting an appropriate definition for a given study; operationalizing the definition; and interpreting and comparing empirical results. They state that a generic definition of satisfaction is impossible to develop given the complexity and context-specific nature of satisfaction and thus they propose a

'framework that researchers can use to develop clear and conceptually consistent, context-specific definitions of consumer satisfaction'.

The framework is to be based on the commonalities in the literature and the views of consumers.

They examined 20 definitions used during a 30-year period of consumer satisfaction research and conducted group and personal interviews. They found satisfaction to comprise three basic components: '*a response pertaining to a particular focus determined at a particular time*'. They found the response to be affective (i.e. emotional) in nature and varying in intensity. They noted that the affective nature of the response does not preclude the importance of cognitions in determining satisfaction, because although cognitions are the bases for satisfaction formation; cognitions are not satisfaction. Cognitive deliberations reflect the process by which the affective state is formed.

They then suggested the following definitional framework:

"Consumer satisfaction is a summary affective response of varying intensity with a time-specific point of determination and limited duration and directed toward focal aspects of product acquisition and/or consumption."

They further recommend that the researcher must define explicitly, the exact type of affective response and the level of intensity likely to be experienced; the point of determination most relevant for the research questions; and the focus of interest based on the managerial or research question of interest.

From the foregoing, it can be said that satisfaction is essentially an affective state that reflects the individual's feelings towards his or her cognitive evaluation of the performance of aspects or the whole of a product or service at a time that could be during, immediately after or long after experiencing the product or service.

In the context of this thesis therefore:

Satisfaction in transport is defined as the individual's affective response to his or her cognitive evaluation of the whole transport service experience (or an aspect of the service) after using it.

The issues relating to the cognitive evaluation process will be considered in the following sections.

3.2.2 Satisfaction Formation

3.2.2.1 Antecedents of Satisfaction

Satisfaction formation is influenced by several factors and these factors are considered as the antecedents of satisfaction. The key factors considered to affect consumer satisfaction include perceived performance, expectations, disconfirmation, and prior attitudes (Yi, 1990; p.79), although only the first three are generally considered as the antecedents of satisfaction (Bolton and Drew, 1991). However, these antecedents are based on certain fundamental characteristics of both the transport service and the user. Figure 3.1 below illustrates these relationships.

Perceived performance is the term used for the consumer's perception of the performance of a product or service. It is a subjective value, being dependent on the consumer and it may differ from the actual performance. However, it is a function of the actual performance of the product or service.

Expectation refers to the level of service or performance that a consumer anticipates they would experience on purchasing and using a product or service. Expectation can be formed from prior experience of the product or service; word of mouth from other users; personal needs, desires and values; and even product/service advertisements

(Parasuraman et al, 1985 & 1988). In most Customer Satisfaction/Dissatisfaction (CS/D) studies, (e.g. Oliver, 1980a; Cadotte et al, 1987), expectation is considered to be a frame of reference about which a consumer makes a comparative assessment of the product or service.

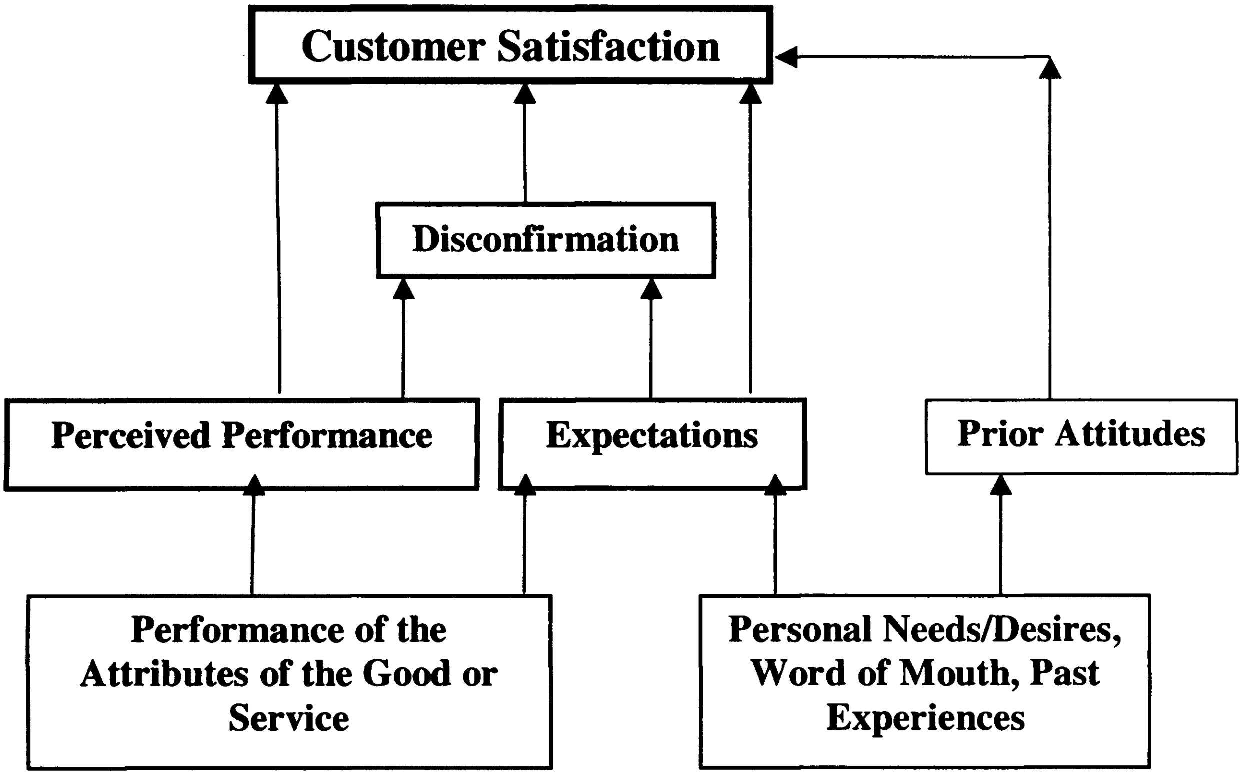


Figure 3.1 Major Antecedents of Customer Satisfaction

Disconfirmation is the result of a comparison between what was expected (or desired) and what was observed (Oliver, 1997 p.27). It refers to the psychological interpretation of an expectation- (or desire-) performance discrepancy. Disconfirmation is also considered to be subjective, as the performance observed or perceived would vary with the person making the observation.

Prior attitude refers to the attitude held by the consumer towards the product or service before purchase and consumption. Oliver (1997, p.27) defines attitude as "*a* *stable affect-like judgement that a product (or object) has desirable or undesirable properties*", where the judgement is based on many separate evaluations of product features and takes the form of a liking or disliking. Unlike affect which can exist as 'pure feeling', attitudes result from deliberate processing of product or service related information. Like expectations, prior attitude is influenced by experience of the product or service, word of mouth from other users, personal desires and product/service advertisements. In fact Oliver (1980a) found prior attitude to be a function of expectations. Yi (1990) reports mixed findings on the effect of prior attitude on satisfaction – while Oliver (1980a) found a significant effect, Bearden and Teel (1983) did not.

Other less weighty factors considered to influence satisfaction include demographic or socio-psychological characteristics of consumers (Yi, 1990) and cognitive themes such as equity and attributions (Folkes, 1984; Oliver & DeSarbo, 1988; Oliver & Swan, 1989; and Patterson & Johnson, 1995). While several authors (see Yi, 1990 for list) have found relationships between satisfaction and such characteristics as age, personal competence, education, marital status and race, some others failed to find any relationship between satisfaction and age or education. Thus support for the relationship between customer satisfaction and these factors seems weak (Westbrook and Newman 1978).

The equity factor suggests that in making satisfaction judgement, consumers consider whether the ratio of their input to the outcome is fair relative to the ratio of others. Thus satisfaction is thought to occur when the consumer perceives that their outcome-to-input ratio is proportionate to that of the other person (e.g. seller/supplier of product or service). Attribution, which is the assignment of cause for outcome (good or bad) to self or others, has been found to have a relationship with satisfaction such that satisfaction scores are higher for self-ability and self-effort attributions than for attributions to others' efforts or to luck (see Oliver and DeSarbo, 1988, p.496-497).

Equity and attribution have not generated much interest in the CS/D literature. Oliver (1997) in summary considers them to be secondary influences on the main satisfaction determinants – expectation-disconfirmation and performance. In a study by Oliver and DeSarbo (1988), models of satisfaction based on equity and attribution, were not tested against the major satisfaction models (to be discussed below), but rather, they were used to provide complementary response styles.

3.2.2.2 Satisfaction Formation Models

From the CS/D literature, several models have been advanced to explain the formation of consumer satisfaction. These models attempt to postulate which antecedents of satisfaction are involved in the cognitive evaluation process and how they interrelate.

The focus of satisfaction as discussed in Section 3.2.1 is directed towards a product or service and traditionally, satisfaction has been analysed using a performance-based approach (Oliver 1997). This approach assumes that a customer's perception of the performance of a product or service and his or her preferences between the attributes or dimensions describing the product/service are sufficient to measure their satisfaction with the product/service. Generally information about the importance of individual attributes to the consumer, and their perception of the performance of the product or service on each attribute is collected and an importance-performance analysis (Martilla and James, 1977) performed.

Measurements based on this approach have been used for lots of studies in practically every sector where satisfaction has been studied. (See for example, TRB, 1999; Burns, 2000; TCRP, 2002; Chu 2002). Such measurements are mostly used to determine the attributes of the service or product that are key to the satisfaction of the consumers. This knowledge is to help managers concentrate on improving such key attributes. These measurements are also used to record trends in average consumer satisfaction with the product or service and to establish benchmarks that enable comparisons of competing producers or providers. There are usually no attempts to determine the relation between performance and satisfaction or explain how the consumer responds to the stimuli of the performance levels they experience. In line with performance-based approaches, satisfaction measure instruments have been developed such as SERVPERF (Cronin and Taylor 1992); and the negative critical incident (NCI) approach (Friman et al, 1998, 2001 & Friman and Garling, 2000).

SERVPERF was developed as a parallel model of SERVQUAL (Parasuraman et al, 1988) but using only performance perceptions where SERVQUAL uses performance perceptions and excellence expectations. The SERVQUAL score is calculated from the formula:

$$Q_j = \Sigma(P_{ij} - E_i)$$

where Q_j = quality 'gap' for company j

Σ = summation over all dimensions, features or attributes of the service

P_{ij} = performance perception for company j on dimension i

E_i = excellence expectations for dimension i

SERVQUAL was originally developed to predict service quality with the performance of the service measured along five pre-defined general dimensions of "Tangibles", "Reliability", "Responsiveness", "Assurance", and "Empathy". However, the universality of these dimensions has been tested in several studies (e.g. Cronin and Taylor 1992) and results indicate that they are not generalisable. It was found that for any particular service's context, there is a need to pre-test the instrument to eliminate superfluous dimensions and identify omitted critical dimensions of the service performance.

The negative critical incident approach is based on the critical incident technique (CIT) – a qualitative method for assessing service quality – developed and defined by Bitner and others (Bitner et al, 1985 & 1990). CIT approach requires that service providers should focus on "critical incidents" that make customers happy or unhappy. The negative critical incident (NCI) approach collects information on the negative critical incidents experienced by consumers. Friman and Garling (2001a) used this approach for measuring transport satisfaction on the premise that in transport, negative incidents which lead to dissatisfaction are more relevant to satisfaction since transport users are assumed to aim mainly to minimise dissatisfaction. In another study (Friman and Garling, 2001b), an attempt was made to relate transport service performance to overall satisfaction via the mediating influence of 'frequency of NCI' (FNCI). While the authors found that there was a significant direct relationship between service performance and overall satisfaction, their hypothesized relationship between service performance and FNCI failed to reach significance. They concluded that

> *"measuring user's satisfaction by means of the critical incidence technique will most likely fail to reveal all attributes of service performance that are important. A multi-method approach is therefore recommended to measuring user's satisfaction with public transport services."*

Since satisfaction has been defined as an affective response to a cognitive evaluation, limiting its measurement to performance perceptions alone is counter-intuitive, as this would exclude the necessary comparative exercise involving standards based on the preferences that influence emotions or feelings. Oliver (1997, p.38, 39) states that performance levels exist only as external stimuli to consumers and that performance based approaches ignore the psychological processing of performance. It is this psychological processing that generates the "affective response to the cognitive evaluation". Thus studies in the CS/D field have been based on the premise that there is more to satisfaction than can be explained by consumer perception of performance alone.

Earlier consumer satisfaction studies (Anderson (1973); Olshavsky and Miller (1972); & Olson and Dover (1979)), building on findings from the social psychology field (Hovland et al, 1957) about the behavioural tendency of assimilation, considered expectations to play a major role in satisfaction formation, being able, prior to consumption, to predispose the consumer to respond to the product in a certain way. The assimilation effect provided the basis for an expectations-based approach to satisfaction formation. This effect is that people are reluctant to acknowledge discrepancies from their previously held view and therefore adjust their judgement towards that view. Thus the perception of performance is then assimilated into the initial expectation level. In this approach, it is considered that expectations have a direct and major effect on satisfaction.

An opposing view to the assimilation effect – the contrast effect (Dawes et al, 1972) – held that people have a tendency to exaggerate the discrepancy between their view and the views of others such that performance which is below expectations is rated worse than it really is, while performance which is above expectations is rated much better than it really is. Oliver (1980b) proposed that this contrast effect is actually a form of discrepancy reaction implying that the exaggeration is actually the consumer's response to the difference between his or her expectations and the performance of the service. This view led to the development of the model of disconfirmation of expectations (Oliver, 1994).

This model of disconfirmation of expectations assumes that consumer expectations create a standard or frame of reference against which consumers compare product performance and it postulates that satisfaction is related to the size and direction of the discrepancy between prior expectations and actual product performance (Swan and Combs 1976; Oliver 1980a; Barber and Venkatraman 1986). The implication is that confirmation occurs when product performance is equal to prior expectations and this leads to satisfaction. Conversely, disconfirmation occurs when performance does not equal prior expectations. When product performance exceeds prior expectations, positive disconfirmation results and this also leads to satisfaction. On the other hand, negative disconfirmation results from performance being lower than expected and this leads to dissatisfaction.

Accordingly, satisfaction is the outcome of confirmation or positive disconfirmation while dissatisfaction is the result of negative disconfirmation. Confirmation can be said to occur when performance exactly matches expectations. A disconfirmation of expectations variable is thus included as a mediating concept in the satisfaction process rather than assuming a process with a direct link between performance and satisfaction or expectation and satisfaction. See Figure 3.2 below.

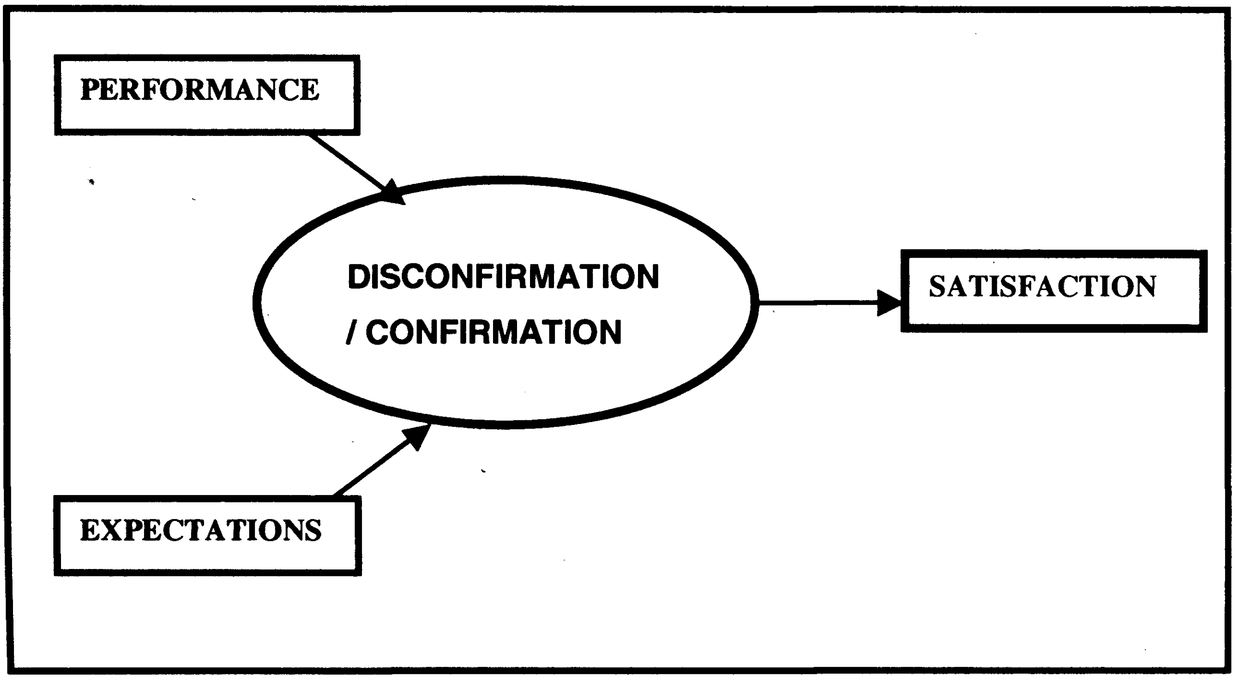


Figure 3.2 The Disconfirmation Model

Westbrook and Reilly (1983) proposed a value-percept disparity model as an alternative to the expectation-disconfirmation model. They considered that what is expected from a product is different from what is desired or valued in a product and that success in relation to aspirations or values (as opposed to expectations) is more relevant to satisfaction formation. They also considered that consumers show satisfaction/dissatisfaction for aspects where expectations never existed. The value-percept disparity model asserts that satisfaction is an emotional response triggered by a cognitive-evaluative process in which the perceptions of an object are compared to ones values (needs, wants, or desires). The greater the disparity between the perceptions of the product or service and one's values, the greater the dissatisfaction predicted by this theory. Conversely, the smaller the value-percept disparity, the greater the satisfaction is.

In their study, Westbrook and Reilly (1983) found that neither the expectation-disconfirmation model nor the value-percept model was sufficient on its own. Instead, both constructs were needed in attempting to explain consumer satisfaction. Similarly, Khalifa and Liu (2002), combining expectations disconfirmation, desire disconfirmation, and perceived performance in a model, were able to explain over 80% of the variance in overall satisfaction. This suggests that the comparative standards, against which performance perceptions are weighed, are multidimensional involving both expectations and desires.

However, Yi (1990) holds that the value-percept disparity model can be seen as a special type of the norm-based model. The norm-based model basically suggests the use of normative standards of performance as comparative standards, instead of brand expectations that are more like "predictions" (Woodruff et al., 1983). A test by Cadotte et al (1987) found the norm model to be better than the brand expectation models in explaining consumer satisfaction. In this approach, satisfaction results from the degree to which perceived performance matches the norm. Suggested norms include product-type norms, and best-brand norms.

Woodruff et al. (1983) have suggested that prior experience of the product type and not only of the brand is the determinant of both norms and expectations. They also developed a modification to the confirmation/disconfirmation paradigm incorporating prior experience as the source or basis of the comparative standards by which disconfirmation is formed. Thus they acknowledge that consumers could have a broader experience than just the particular brand in question. This concept therefore accommodates the possibility that people have relevant experience and hold expectations even before ever using a product brand. Woodruff *et al* (1983, p.298) cite research findings by Cadotte et al (1982), LaTour and Peat (1979b), and Swan and Martin (1981) that "experience-based evaluations of a comparison brand are better predictors of satisfaction than evaluations using focal brand expectations". Thus experience is considered to be a more appropriate comparative standard than expectations. Now this depends on whether or not the expectations held are limited to one brand or result from the combined experiences of many brands of the product-type. If the second case is true, then, experience and expectations are essentially the same.

Also rivalling the expectation-disconfirmation model, Oliver and Bearden (1983) found that the importance of expectations, as a determinant of satisfaction, decreases for high involvement products and the importance of outcomes or performance increases. (High involvement products or services refer to products or services with which the consumer has greater or more intense interaction – Oliver, 1997: pp 28). Accordingly, performance becomes an independent determinant of satisfaction. After using a product or service, the consumer will note the performance levels of various attributes and then, through a cognitive process (Woodruff et al, 1983), they form perceptions that result in a set of beliefs about how the product/service has performed along some set of performance dimensions. The consumer, however, may note overall performance and form an overall perception and hence an overall belief that is independent of perceptions of the various attributes or dimensions defining the product or service. High levels of perceived performance lead to high levels of satisfaction while low levels of perceived performance should lead to low levels of satisfaction.

This assertion is also supported by Churchill and Surprenant (1982), who investigated the necessity of including disconfirmation in the satisfaction model. They modelled the satisfaction process for two types of products, a durable (video disc player) and a non-durable (potted plant). They found satisfaction with the durable good (the video disc player for which it was possible to define and evaluate performance dimensions), to be mainly determined by the product's performance i.e. solely a function of performance evaluations, whereas satisfaction with the non-durable good (the potted plant, which does not have definable performance dimensions), to be a function of all three constructs of performance, expectations and disconfirmation. They found for the durable good, that performance explained a larger proportion of the variance in customer satisfaction than disconfirmation. For the non-durable good, both effects were significant. Most studies (see Oliver and DeSarbo 1988) in which performance and disconfirmation have been compared have used products that cannot be objectively evaluated on performance dimensions or used a single product without variance on the performance dimension. The few studies in which performance have been manipulated (Churchill and Surprenant 1982, Wilton and Tse 1983, Olshavsky and Miller 1972) have generally found significant performance effects.

Oliver (1989) proposed that customer responses concerning continuously provided services or long-lasting durables are characterized by passive expectations and thus, disconfirmation does not operate unless performance is outside the range of experience-based norms. Thus customers' assessments of continuously provided services, such as public utilities or cable television, may depend on performance evaluations only. Oliver and DeSarbo (1988) also suggests that for goods or services with evaluate-able performance dimensions, customer satisfaction formation appears to depend more on performance effects than on disconfirmation.

A very recent study (Burton *et al*, 2003) found that actual performance is a significant predictor of customer satisfaction, separate from its indirect association. The complexity of the role of performance in satisfaction formation had been empirically demonstrated, showing either direct performance effects jointly with disconfirmation, indirect performance effects mediated by disconfirmation, or combined indirect and direct effects (Anderson & Sullivan, 1993; Bolton & Drew, 1991; Oliver, 1993; Tse & Wilton, 1988). Thus, Bolton and Drew (1991) considers the antecedents of satisfaction: perceived performance levels, prior expectations and disconfirmation, to be 'potential' as the evidence from these studies suggest that the contribution (or non-contribution) of each of these antecedents to a customer's satisfaction depends on the type of good or service that is being evaluated. That is, the nature of the product or service determines the dominant satisfaction antecedent in the individual customer's satisfaction formation process.

From Oliver (1997, p. 121-122) this variation in significant antecedents in the satisfaction model has also been seen to occur when aggregated results are compared with judgements of individuals. He reports a study (Oliver and DeSarbo 1988), which showed that while all the antecedents were significant at the aggregate level, the individuals sampled used varying combinations of the antecedents in their judgement process. Oliver and DeSarbo (1988) also found that performance and disconfirmation may operate in tandem and that individuals may respond separately to the two concepts even though they appear related. They suggest that performance-oriented individuals (i.e. individuals whose satisfaction formation style is more strongly influenced by performance outcomes) tend to have more knowledge and experience with regards the product or service than disconfirmation-oriented individuals (i.e. those more influenced by disconfirmation). This suggests a user vs. non-user demarcation, which could be quite significant for market segment studies.

However, Friman and Garling (2001b) commenting on studies that have investigated expectations, disconfirmations and performance for most influential effect on public transport satisfaction, reports that expectations seem to dominate when people are unable or unwilling to judge performance due to ego-defence or practical reasons; disconfirmation seems to dominate when people are more involved, and recognise and are willing to accept discrepancies from expectations; and performance dominates when people have limited prior experience and thus are unable to reflect on performance. While both of these studies (Oliver & DeSarbo, 1988 and Friman & Garling, 2001b) identify varying degrees of influence of the antecedents of satisfaction, they offer different explanations for the satisfaction formation styles of individuals.

The reasons proffered by Friman and Garling (2001b) for the influence of performance are in direct contrast to those given above by Oliver and DeSarbo (1988). It can only be deduced that here again, the product/service type is influencing the satisfaction formation process, for while the product/service investigated by Oliver and DeSarbo (1988) is a stock market transaction, that investigated by Friman and Garling (2001b) is public transport. Perhaps, this is because the stock market transaction is very result-oriented (was the decision to buy/sell right or good?) while the transport service is more process-oriented (how well did the whole service from A to B meet my needs/desires?). Thus, it does appear that the user vs. nonuser demarcation with respect to satisfaction formation processes may only be relevant within a specific product/service type i.e. when considering a specific product/service.

The Expectancy-Disconfirmation-Performance (EDP) model of satisfaction proposed by Oliver (1997), includes a performance evaluation that may have a direct, or an indirect effect on satisfaction. The EDP model assumes that satisfaction is directly influenced by performance outcomes as well as by an independent effect of disconfirmation. Yet performance outcomes may sometimes dominate judgement if general performance standards override goals that are related to specific expectations (e.g. Oliver 1993). Expectations may also directly influence satisfaction by changing the perception of performance outcomes, either through assimilation or contrast effects. The EDP model is shown in Figure 3.3 below.

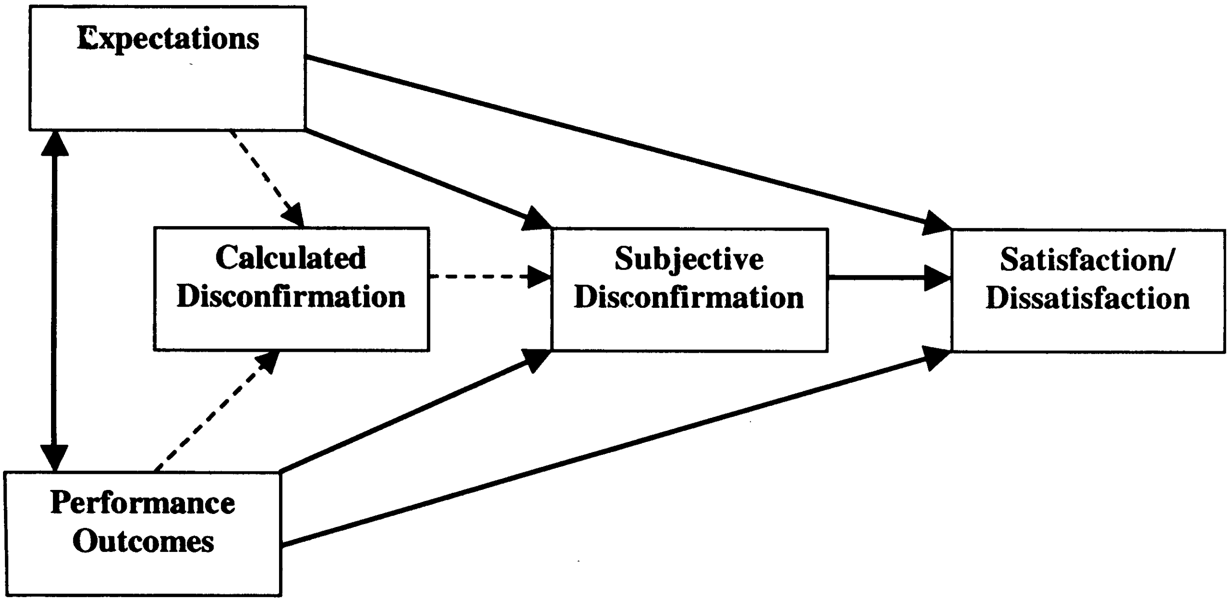


Figure 3.3 The Expectancy Disconfirmation with Performance Model of Consumer Satisfaction.

(Source: Oliver 1997, pp. 120)

Due to the sometimes mixed and conflicting findings from the numerous conceptual and empirical studies conducted in the CS/D field (see Patterson & Johnson, 1995), numerous variations of the disconfirmation of expectations model have been suggested. Oliver (1997), with respect to his proposed EDP Model, also acknowledges that not all the constructs in the model operate at all times and in all contexts. In addition to the issues discussed above (i.e. the dominance or otherwise of any one construct due to product/service type and also to individual differences in response style), he suggests that certain attributes of the product/service may have different response characteristics.

A study by Halstead *et al* (1994) seems to confirm this. They tested, with respect to the operation of performance and disconfirmation only, two attribute dimensions – intellectual environment and employment preparation – in prediction of satisfaction with higher education. They found for the employment dimension, performance was fully mediated by disconfirmation and only disconfirmation affected satisfaction directly. While for the intellectual dimension, only performance affected satisfaction and disconfirmation did not affect satisfaction directly even though it was related to performance.

Thus Oliver (1997) advocates an attribute-specific (dimension-specific) operation of the EDP model i.e. determining attribute by attribute which variation of the EDP model is in operation and for each attribute, entering its specific operating antecedent(s) in the function for overall satisfaction instead of developing an aggregated EDP model at the overall product/service level. This suggests a two-stage process for satisfaction analysis: determining attribute-specific functions and entering them into another function for overall satisfaction.

Costantino et al (1974) in assessing consumer preferences for automated public transportation systems concluded that people's satisfaction with transport attributes have an effect on overall satisfaction, satisfaction differences amongst modes and allocation of trips among modes. Their study found that overall satisfaction could be explained in terms of attribute satisfaction through the use of linear additive models. They, however, did not attempt to explain or model attribute satisfaction formation or determine their predictive factors. They suggested that further work on stratification by socio-economic and demographic variables; more thorough process of attribute selection; and clearer understanding of how respondents perceive and evaluate each attribute would improve their models.

While the EDP model has received widespread acceptance amongst researchers in explaining customer satisfaction in different product and service sectors, its use for the development of a predictive model of customer satisfaction, as it is desired to do in this thesis has not been so straightforward. Perhaps, this is because the EDP model has so many possible variations to it depending on the type of the product, the nature of the attributes or dimensions of the product or service, and even on the response style of the individual. From the present review of the literature, it is difficult to say conclusively, *a priori*, which variant of the EDP model would be most suitable for modelling transport user satisfaction. However, this dependency on product type, nature of product attributes and individual consumer response style for determination of appropriate or relevant satisfaction antecedents seems to suggest an approach that measures in greater detail, the variation in individuals and specifies in greater detail the attributes or dimensions that describe the product/service.

Looking again at Figure 3.1 above, it seems that satisfaction could be represented by a function of the performance of the attributes of the service, personal needs (or preferences) of the user, past experience and previous knowledge (via word of mouth). It seems possible that a model that has inputs for these variables would capture effectively, the effects of any super-ordinate antecedents in operation. Also in the development of a practical model, it is essential that the predictive variables be defined in measure-able forms. Therefore, in this thesis, rather than setting out to measure expectations and disconfirmation variables, a different approach will be used to develop a model of transport satisfaction which involves the factors that form the known antecedents of customer satisfaction as shown in Figure 3.1. These factors will be considered for use as variables in directly developing a transport-user satisfaction model. The relationship for such a model is shown in Figure 3.4 below. The next section will attempt to develop a proposal for this model.

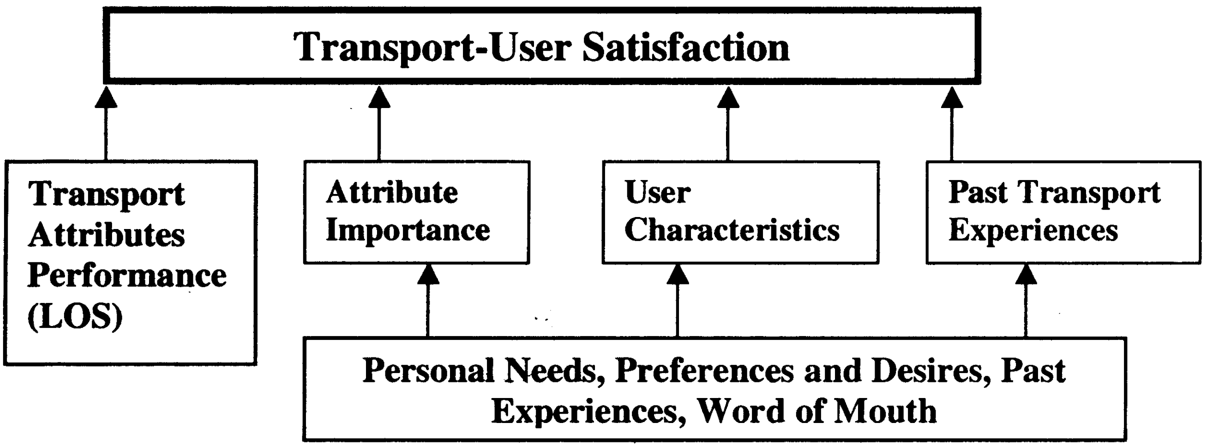


Figure 3.4 Proposed Transport-User Satisfaction Model

3.3 TRANSPORT SATISFACTION

3.3.1 Transport Satisfaction Measurement and Modelling

Measures of customer satisfaction (TRB, 1999a and Karlaftis et al, 2001) have been developed to provide a comparative basis for assessing the level of satisfaction in relation to the services provided by transport operators. These measures are aggregated and provide a current status evaluation. While they are useful as performance measures and in helping the operators involved identify areas for improvement, they cannot be used to predict a user's satisfaction with a service to be provided for a future trip. Bolton and Drew (1991) suggest that instead of service providers just focusing on maximizing average customer ratings of service quality while minimizing costs (i.e. price), they must offer flexible services that satisfy the different tastes and expectations of each market segment since expectation-disconfirmation and desire-disconfirmation have a considerable effect on satisfaction.

Studies involving service quality measures (e.g. Prioni & Hensher, 2000), have also been conducted in the transport industry to help develop indices by which transport operators can evaluate their respective customers' assessment of the quality of their services. Although service quality and satisfaction are causally related (via perceived service quality) (McDougall & Levesque, 2000), they are separate and distinct concepts (Oliver, 1997), because while quality is a judgement of performance with excellence as the comparative basis, satisfaction is the user's fulfilment response or the degree to which the level of fulfilment is pleasant or unpleasant (Oliver, 1997). Also, while the quality judgement can be made without experiencing the service, the satisfaction judgement requires an experience of the service.

Unfortunately the terms have often been used interchangeably. For example, see Getty (1999). This author states,

> *"Thus a customer satisfaction model measures product or service quality, both in terms of customer satisfaction and employee satisfaction".*

This is an example of the improper use of the satisfaction term. If satisfaction and quality are the same construct, then all customers will have the similar satisfaction levels for the same product, which also implies that they will all go for the same product if it is of the highest quality in the market. But this is not so. Because people have different needs, tastes and preferences, they receive different satisfaction levels for any one product or service at any time *t* even though the quality of that product/service may not have varied in that time *t*.

In the development of user satisfaction models, measures, instruments and scoring systems, although a lot has been done in job satisfaction, patient satisfaction, life satisfaction and even internet-use satisfaction (e.g. Cho et al, 2000), the literature surveyed so far does not indicate much of such work in the field of transport. Although satisfaction modelling for predictive purposes is rare in the transport literature, other fields have begun to explore the possibilities. Models have been developed to predict patients' satisfaction with health care received; community satisfaction among rural residents; job satisfaction; life satisfaction; recreation satisfaction; technology-licensee satisfaction and satisfaction with internet-based services (see for example, Fu and Perkins, 1995; Filkins et al, 1998; Hart, 1999; Burns, 2000; Dolan and Gosselin, 2000; and Khalifa and Liu, 2002). Thus the next section will consider the development of a predictive model of transport satisfaction.

3.3.2 Transport Satisfaction Model

Developing a predictive model of transport satisfaction requires a consideration of the established consumer satisfaction formation process. From Section 3.2, the consumer satisfaction formation process involves, primarily, the factors of performance, expectancy and expectancy disconfirmation. As explained in Section 3.2.2, there is a considerable degree of inconclusiveness about the inter-relations and operations of these currently known antecedents of consumer satisfaction. It seems better to develop a predictive model based on the basic features on which these antecedents (performance, expectancy and expectancy disconfirmation) depend i.e. the characteristics of the service and of the user than on the antecedents themselves. (See Figures 3.1 and 3.4). This is because, while an understanding of the inter-relations and operations of these antecedents is useful, it is not essential to the development of a predictive model of transport satisfaction.

Such a model is proposed in this thesis for use in transport-user satisfaction modelling. It is expected that a model relating satisfaction to the performance of the specific attribute of the transport service and to characteristics of the individual user including past experience would adequately represent a transport-user's satisfaction formation process. This model proposal is based on the following reasoning:

For any service experience, the consumer comes with an Expectancy E, he or she experiences a service Performance P, and a Disconfirmation value D. Based on the expectance-performance-disconfirmation theory, a satisfaction function could be expressed as Satisfaction = F (E, P, D). For attribute-based satisfaction analysis, E, P, D and Satisfaction can be expressed as E_i, P_i, D_i and Satisfaction_i respectively for each attribute i.

$$\therefore \text{Satisfaction}_i = F(E_i, P_i, D_i)$$

Now, E_i, P_i, and D_i can each be expressed in terms of the service performance experience.

Expectation, which is based primarily on past experience (personal or otherwise), is a certain value in the same unit as performance of the attribute of interest.

$$\therefore E_i = \text{Constant} = K_i$$

Performance is the attribute performance.

$$\therefore P_i = P_i$$

Disconfirmation is a subjective interpretation of the difference between Expectation and Performance.

$$\therefore D_i = f(E_i, P_i) \equiv a(P_i - E_i)^b + c \equiv a(P_i - K_i)^b + c \equiv a(P_i^*)^b + c$$

If the exponent b is assumed to be 1, i.e. assuming a linear relationship between Disconfirmation and P_i^* the difference between Expectation and Performance, Satisfaction can be taken as follows:

$$\therefore \text{Satisfaction}_i = F(E_i, P_i, D_i) \equiv a(P_i^*)^b + c$$

Essentially, therefore, satisfaction decomposes to a function of performance with a constant term. The constant term c is assumed to represent the constant information about the user such as his or her socio-economic/demographic data, preferences and past experience(s). Consequently, it is postulated that by determining the relationship between attribute satisfaction and attribute performance, a proxy measure of the user's experience; and including variables representing the user's characteristics and preferences, and then the relationship between the attribute(s) satisfaction and overall satisfaction, it is possible to develop a predictive model of transport-user satisfaction.

Variable inclusion in a predictive model of transport-user satisfaction for use in a brokerage setting is constrained by the relevant available information accessible to the transport broker. Such information could be expected to include vehicle performance on specified attributes, some socio-demographic data on the user, and the user's preference or importance value for each attribute (Bearden and Teel (1983) found that attribute importance, in addition to user characteristics, affected consumer satisfaction). Thus the variables to be used in this model specification will be limited to such readily accessible information. Therefore, the following relationship is proposed:

$$\text{Overall Satisfaction} = \boldsymbol{F}^{i}\,(\text{Attribute}_i\ \text{Satisfaction, Attribute}_i\ \text{Importance})$$

where

$$\text{Attribute}_i\ \text{Satisfaction} = \boldsymbol{G}\,(\text{Attribute}_i\ \text{Performance, User Characteristics}).$$

Attribute$_i$ importance is a measure of the strength of the user's preference for a specific attribute (i) of the system.

Extensive evidence from psychological studies of judgement and decision making supports the existence of a common utility function for individual decision makers i.e. that for any particular decision, the functional form of people's preferences tends to be fairly stable across the population, even though the parameters of the function may vary widely (Lerman and Louviere, 1978; and Meyer et al, 1978). Thus for each attribute, a common functional form can be derived for the selection of users surveyed. The satisfaction function for each attribute$_i$ is expected to model how the individual judges his/her experience of the attribute to arrive at a decision of satisfaction or dissatisfaction for that attribute. This experience of the user is related to the level of service (LOS) provided by the transport option for that attribute. It is acknowledged that for different individuals the same level of service can be judged differently.

Therefore to understand and model the individual's judgement process, the relationship between perceived values of an attribute and actual measured values should be known. Stevens' Law (Stevens 1957) states that perceived values are a power function of actual values i.e. PV = $a(\mathrm{AV})^b$ where a and b are coefficients related to characteristics of the particular phenomenon involved. This formula has been shown to hold for uni-dimensional sensory continua such as length of lines, travel time and loudness of tones (Petrov, 2000; Clark, 1982 and Horowitz, 1978).

For less objective phenomena such as the travel attributes to be considered in this study, it is expected that the relationship between actual and perceived values would be more complex. McCord and Villoria (1987) suggest that the relationship is a function of both the level of service and the individual's socio-economic characteristics. It follows from this that the user's perception of the service would be influenced by and therefore would depend on some of his or her personal characteristics such as age, gender, disability status and life-stage position. Thus the following functional relationship has been proposed:

Attribute$_i$ Satisfaction = ***G*** **(LOS$_i$, Preference, Age, Gender, Disability Status, Occupation, (Prior Transport Experience Variables)$_i$).**

The prior transport experience variables represent the user's past transport experiences. They are included because as stated above, the proposed model is based on the factors that affect both perceived performance and expectations, one of which is prior experience. Also, past experience has been shown to have a moderating effect on satisfaction formation (Patterson and Johnson, 1995). LaTour and Peat's (1979) study examined the impact of experience in isolation from other key disconfirmation constructs and concluded that experience was significant in explaining variations in CS/D. Similarly, Woodruff, Cadotte and Jenkins (1983) stated

> *"...consumer experience with an evoked set of brands are important determinants of CS/D processes".*

Income is not included in this function as a variable (even though it is likely that it would have an influence on a user's perception of a service) for two reasons: First, it is one parameter for which it is difficult to get correct information during surveys. Second, in the development of a practical framework, it is important that the information requirement is such that its acquisition is feasible in everyday usage. Income is an attribute most people feel sensitive about (considering it private and an indication of their worth). Also, unlike the variables of gender, disability, age and life stage, income is more volatile – liable to changes upward and downward. It is assumed that the use of occupation as the life stage variable would serve as adequate proxy for the influence that income would have had.

Thus for the computation of attribute satisfaction, the function G would be used for each transport user. It is expected, in line with the findings of Lerman and Louviere (1978) and Meyer et al (1978) that the functional form of G would not vary from person to person. There does not appear to be any contrary finding to this in the literature. More recently, Ortuzar and Willumsen (1994, p.252 and 2001, p.280) also support this assertion.

3.3.3 Hypothesis Formulation

Based on the foregoing literature review, it is hypothesized in this thesis, that a Transport-User Satisfaction Model (TUSM), derived for the prediction of overall transport satisfaction as proposed in Section 3.3.2 above, would adequately estimate a transport-user's satisfaction ratings for various transport options. To verify this, three hypotheses have been proposed and will be tested in this thesis. These hypotheses are presented as follows.

3.3.3.1 Hypothesis 1

Hypothesis 1 states that, for every attribute, the changes in attribute satisfaction values can be explained by changes in the independent variables. The independent variables in the function are the characteristics of the user and the transport service – the Level of Service (LOS) of the transport attribute, the user's strength of preference for the attribute i.e. Importance (IMP), Age, Gender, Disability Status, Occupation, Past Transport Experiences.

The test of this hypothesis will be based on the significance of the regression equation i.e. by the F-test results for the regression. This is because the F-test helps determine the significance of the ratio of the variance in attribute satisfaction explained by the independent variables with the total variance in attribute satisfaction. The test of this hypothesis is important because the reliability of the output of the TUSM model depends also on the reliability of its input values. This test will be presented in Section 7.2.1 after the models have been estimated and presented in Chapters 5 and 6.

3.3.3.2 Hypothesis 2

Hypothesis 2 states that there is a significant relationship between the user stated satisfaction and the satisfaction value computed using the Transport User Satisfaction Model. The strength of the relationship between the satisfaction predicted by the model (Sat_{TUSM}) and the satisfaction stated by the user (Sat_{user}) provides an indication of the potential of TUSM to represent a transport user's satisfaction formation process, and of its use directly or indirectly in predicting transport user satisfaction.

The test of this hypothesis will be based on the significance of $\rho_{m:u}$, the correlation coefficient between Sat_{TUSM} and Sat_{user} i.e the significance of the strength of the linear relationship between Sat_{TUSM} and Sat_{user} given the size of the dataset. This test will be presented in Section 7.2.2 after the estimated attribute satisfaction models have been combined to form the algorithm for the overall transport-user satisfaction model and the correlation coefficient $\rho_{m:u}$ has been computed..

3.3.3.3 Hypothesis 3

Hypothesis 3 states that there is no significant difference between the model-computed satisfaction value and the user stated satisfaction value.

The test of this hypothesis will be in the acceptance or rejection of its statement. This test will be presented in Section 7.2.3 after the estimated attribute satisfaction models have been combined to form the algorithm for the overall transport satisfaction model and used to estimate the users' overall satisfaction values.

3.4 CONCLUSION

This chapter has reviewed the literature on consumer satisfaction – its concept and formation process. The current EDP model has not been found to be suitable for use in the development of a predictive model of transport-user satisfaction for two reasons: its instability with respect to form and nature of its explanatory variables (i.e. Expectation, Performance and Disconfirmation) and the difficult in measuring these variables for daily predictive use.

Thus, an alternative model of transport-user satisfaction based on the primary factors that influence these variables has been proposed. Several hypotheses have been postulated with respect to the proposed model and its sub-models. The following chapters will present the design and conduct of the study necessary to develop the proposed model and test the hypotheses.

CHAPTER 4

MODELLING TRANSPORT-USER SATISFACTION

4.1 INTRODUCTION

In the previous chapter, the literature on satisfaction – its concept and formation process – was reviewed; and a model of transport-user satisfaction was proposed. This chapter will present the issues pertinent to the development of this model and to the design of a study to test whether the proposed Transport-User Satisfaction Model (TUSM) can adequately estimate an individual's satisfaction rating for several transport alternatives. This study involves the design and conduct of a survey to obtain data on the variables with which the Transport Satisfaction Model could be developed. It also involves the development of a framework for the use of this model in a transport brokerage.

Section 4.2 presents an overview of the issues pertaining to modelling in transport while Section 4.3 reviews the literature on methods suitable for satisfaction modelling with particular application to travel attribute satisfaction and overall transport satisfaction. In Section 4.4, the literature on attributes of travel is reviewed and a list of travel attributes compiled and the chapter is concluded in Section 4.5.

4.2 MODELLING APPROACHES IN TRANSPORT

4.2.1 Introduction

Models are very useful tools in decision-making in the transport field. They are commonly used for planning, design, operations and management purposes. Most transport models focus on the concept of choice and demand, and they are usually probabilistic in form to take into account the uncertainty involved in anticipating people's choice. Several aspects of travel are modelled such as destination choice, modal choice, travel demand etc.

The development of choice theory has been influenced by both economic and psychological impressions of human behaviour (Bolduc and McFadden, 2001). Psychological perspectives to the human choice problem led to the development of attitudinal and cognitive models that Levin (1981, p. 173) defines as "*descriptions or predictions of behaviour that stress the role of subjective perceptions, judgements and evaluations.*" The economic perspective produced the constant and random utility models of which the multinomial logit model (MNL) is popular and has proved to be an extremely powerful tool in modelling travel choices. The MNL builds into an explicit mathematical model, parameters and variables characterizing decision-makers, and the alternatives as well as stochastic variation in preferences across the population. Other choice models include the Hierarchical Logit model (HL), the Multinomial Probit model and the Mixed Logit model. Although originally the economic models utilized only objective 'measurable' factors, currently, attitudes and subjective perceptions are being built into them (Ortuzar and Willumsen, 2001).

Recent developments in choice and decision-making have suggested alternatives to the random-utility based models (Bolduc and McFadden, 2001) by querying the assumptions that people are able to consider all the attributes of all the alternatives and then choose the option with the maximum utility or value to them. These developments suggest that people make 'satisficing' decisions rather than preference maximising decisions because people seek to avoid the search costs associated with gathering the necessary information. So instead people use heuristic rules to search until they find an option that meets their basic criteria and then they stop. Proponents of random utility models (RUM) hold that RUM approximates the decision people make and not necessarily the rules by which they make those decisions (Bolduc and McFadden, 2001). In other words, they say that the output of a random utility model would be an approximation of the decision the people would make whether or not the algorithm the model uses is the same as the algorithm or rule the person(s) would use.

While the modelling of transport choice has the thrust of many transport studies, this study is concerned with transport satisfaction. The study of satisfaction in transport could help in providing an input of post-consumption information into a travel demand prediction model. This should enhance such models, as information on satisfaction would predict better future transport choice than would information on current transport choice. This is especially so as it may not always be known whether the identified current choice is the preferred choice or a choice dictated by constraints. Specifically, satisfaction could feed into the choice models by providing attitudinal inputs into the utility term.

As indicated in Section 3.2.1, choice and satisfaction are different concepts. Whereas choice is a decision or a selection based on a value-maximising, - optimising or - satisficing process, satisfaction is an affective (i.e. emotional) response to a cognitive evaluation of an experience. Satisfaction is not so much about making a choice as it is about the intensity of a feeling. While satisfaction has been modelled for other consumer goods and services such as car-ownership, internet-based services and banking services (see Peel et al, 1998; Snee et al, 2000 and Khalifa and Liu, 2002), modelling transport satisfaction is a relatively new concept. Issues specific to transport satisfaction modelling will be considered in Sec. 4.3.

4.2.2 Models

Ortuzar and Willumsen (2001, page 2) define a model as

> *"a simplified representation of a part of the real world – the system of interest – which concentrates on certain elements considered important for its analysis from a particular point of view".*

Models are required to adequately reflect the behaviour of interest in the chosen system. The exactness of reflection required depends on the application for which the model is used. Naive models for rapid estimates of factors which may be relatively unaffected by system changes do not require very exact reflection of system behaviour and thus are developed using little more than experience and limited data. Simple correlative models are developed using extensive quantitative data and considerable computational effort and they can be used to forecast factors when the system varies over the same circumstances as the data. Causal models are developed utilizing both data-relationships and theoretical expectations. The development process is quite insightful, and involves extensive computation effort and, often, difficult validation. They are used for the prediction of critical consequences of system changes.

As models range from naive to causal, their development becomes more complicated as more precise specification of the model is required. However, the costs and difficulties of complicated modelling have to be compared with the expected payoff from the exercise and the quality of the data available. Data quality is affected by measurement errors. Alonso (1968) discussed the need to balance the effects of measurement and specification errors on models. The more complex a model, the less the specification errors, but the more the measurement errors cumulate as the data is processed through the model. Thus Alonso (1968) advocates the use of simpler models whenever the available data is poor, prescribing the following strategies for model building:

> "*Add where possible or else, multiply or divide. Avoid as far as possible taking differences or raising variables to powers. Avoid as far as possible models that proceed by chains*".

These strategies are recommendable as they help dampen the propagation of measurement errors in the modelling process, which can cause errors in the model output.

The two classical styles of approach to the development of models are the deductive and the inductive (Ortuzar and Willumsen, 2001. pp.16). They state that the deductive approach, which involves building a model and testing its predictions against observations, has been found more productive in the pure sciences and that the inductive approach, which involves starting with data and attempting to infer general laws has been preferred in the analytical social sciences. Irrespective of the theoretical approach used, data is essential in model development. In fact, Ortuzar and Willumsen (2001. pp.17) assert

> "*data availability usually leaves little room for negotiation and compromise in the trade-off between modelling relevance and modelling complexity*".

Thus it is observable and easily accessible information that is usually included as variables in a model. Variable-inclusion in a model is also affected by the theory. It is those variables, which from the theory are relevant to the required output, that are collected as data with which the model is built.

Building models involves several stages: specification, estimation/calibration and validation. Issues of model specification include the structure of the model; the specification of variables i.e. the variables to use and the form in which they are to be used in the model; and the functional form of the relationship between the variables. The structure of the model, whether simple or complex, depends on the use to which the model would be put, and a balancing of the cost of model development with its benefit (Alonso, 1968). As discussed above, variable and form of variable used are dependent on data availability and theoretical limitations. The functional form of the model, i.e. whether to use linear forms or the more complex non-linear forms, is usually determined by the theory.

In the development of a model for transport-user satisfaction, it is essential that the theory of customer satisfaction dictate the variables to include in the model. A review of the literature on customer satisfaction theory has been conducted in Chapter 3 and the relevant variables have been identified. Since the expected use of the model is for satisfaction prediction by a transport broker, the availability and accessibility of the variables (from his or her perspective) would also be considered in determining the form in which information on the variable will be presented in the model. Given the nature of the data and the expected source, Alonso's (1968) prescription will be kept in focus, as the model is being developed to ensure simplicity and minimization of error and of error propagation.

4.3 TRANSPORT-USER SATISFACTION MODELLING

4.3.1 Introduction

The theoretical framework for transport satisfaction modelling has been discussed in Chapter 3 and a model proposed for transport satisfaction. The expected model output, i.e. the dependent variable, is the user's satisfaction rating for the assessed transport option. This model is to be applied to the vehicle-selection decision-making process in a transport brokerage. As discussed in Chapter 2, there is a need for transport brokers to be able to be systematic when including user preferences and satisfaction criteria in selecting and providing vehicles to meet users' requests.

Transport satisfaction has been defined in this thesis (Section 3.3.2) as the individual's affective response to his or her cognitive evaluation of the whole transport service experience after using it. A two-stage modelling of the overall satisfaction formation process has also been proposed as follows:

$$\text{Overall Satisfaction} = \boldsymbol{F}\,(\text{Attribute}_i\ \text{Satisfaction, Attribute}_i\ \text{Importance}),$$

where

$$\text{Attribute}_i\ \text{Satisfaction} = \boldsymbol{G}\,(\text{Attribute}_i\ \text{Performance, User Characteristics}).$$

Therefore, there is a need to determine both how the individual attribute satisfaction values are obtained given the attribute performance levels and the user characteristics; and how all the attribute satisfaction values are combined into an overall satisfaction value.

4.3.2 Attribute Satisfaction Modelling

Most studies (e.g. Fu and Perkins, 1995; Moutinho & Goode 1995; Filkins et al, 1998; Hart, 1999; Smith et al, 1999; Burns, 2000; Dolan and Gosselin, 2000; and Khalifa and Liu, 2002) have used the ordinary least squares (OLS) method of multiple regression for estimating satisfaction models. The satisfaction data has been considered to have interval level characteristics. Even when satisfaction has been measured on an ordinal scale, it has, generally, been assumed that if the satisfaction data is rated on a large enough scale (7-point or more), then the properties of interval data could be assumed to apply to the satisfaction data (Lea, 1998).

However, with the development of easily available software for ordered probit/logit binary and multinomial probability model estimation, it has been advocated (e.g. Greene, 1990 & 2000) that the ordered probit/logit methods should be used in the estimation of models of multinomial-choice variables such as bond ratings, opinion surveys, taste test results, etc since the dependent variable is discrete and ordered, and not continuous as required in OLS regression. They consider that when such discrete, ordinal data are estimated by OLS techniques, the obtained parameters are not stable, because the requirement of continuous, interval level data is violated. Although this view is also held by other econometrists, psychologists still hold the view that ordinal data measured on a 7-point or larger scale can be analysed by OLS techniques (see e.g. Lea (1998) and Bryman and Cramer (1994)).

Ortuzar and Willumsen (2001, pp. 284-285) make a distinction between modelling techniques for rank data and rating data. They say that rank data can be analysed by Monotonic Analysis of Variance (MONANOVA) and when converted to choice data, it can be analysed using logit or probit techniques. On the other hand, for rating data (with a semantic scale), they say that multiple regression analysis based on ordinary least squares or weighted and generalised least squares can be used to estimate model coefficients. However, Ortuzar and Willumsen (2001, pp. 284-285) consider that while the least square techniques have the advantage of the ability to obtain goodness-of-fit indicators and measures of the significance of the model parameters; the results of the analysis are influenced by the scale used and this emphasizes the importance of choosing the scale correctly. Unlike a numerical scale, a semantic scale would consist of a list of statements indicating varying degrees/levels of a belief or opinion state – quite similar to an ordered categorical list.

Essentially, these authors appear to take sides with the psychologists rather than the econometricians by suggesting that rating data obtained on an ordinal scale can be analysed using ordinary least squares or weighted least squares or generalised least squares techniques, as long as care is taken to ensure an appropriate scale is used. However, in suggesting how to determine an appropriate scale (in page 290-292), they seem to support the econometrists by suggesting that an ordinal probit approach would eliminate the difficulty of determining an appropriate scale.

A study by Peel et al (1998) comparing the OLS and ordered probit/logit methods found that models (for consumer satisfaction with cars, measured on an ordered 5-category scale) estimated by both methods had the same significant variables but each with different coefficients. It also found marginal improvement on OLS models by the ordered probit and ordinal logit models in terms of predictive accuracy. In the Peel et al (1998) study, the dependent satisfaction variable was measured on a 5-point scale which is lower than the 7-point and above criteria suggested to enable assumption of interval data level for satisfaction model. Perhaps in this case, with a 5-point scale rather than a 7+-point scale, the assumptions of interval scale for the satisfaction ratings may have been inappropriate and hence the difference in predictive ability. Even then, the similarity in significant variables suggests that at least for explanatory purposes, there may not be much difference between the outputs of the two models.

Bettman (1974) has also compared results between multiple regression analysis and multivariate probit analysis of a dichotomous dependent variable (toothpaste attribute satisfaction). He found the results from both analyses to be very similar – although the coefficient magnitudes differed, all signs were the same, statistical significance was almost identical and the relative sizes of the coefficients across the independent variables were very similar. However, he did not present a comparison of the predictive accuracy of both analyses. Bettman suggests that due to the robustness of the multiple regression technique, results from regression need not be different from results from probit analysis even though regression model assumptions are violated. However he acknowledges that substantive conclusions from the two kind of analysis may not always coincide. He also suggests that as more categories are added to the dependent variable range, the multiple regression model could be expected to perform quite well. This is in consonance with the views of psychologists that for a wide enough scale, least square methods are appropriate for ratings. It is also observed here as in the Peel et al study, that for both modelling techniques, similar significant variables are obtained.

The Peel et al (1998) study conducted further comparisons by collapsing their 5-point scale into a 3-point scale and re-estimated the models using OLS and ordered probit/logit techniques. They found a greater difference in the predictive accuracy of the models with the ordered probit/logit models out-performing the OLS with a greater margin than before. However the significant variables remained the same as in the previously estimated models. From their study, it could be suggested that the narrower the scale of measurement, the worse OLS is in predictive accuracy. However, it is not certain if the converse of this would hold – i.e. the wider the scale of measurement, the better OLS is in predictive accuracy even though Bettman (1974) has suggested it.

In addition, further consideration of the output of the models by Peel et al (1998) by this author revealed a constant ratio for probit:OLS coefficients of about 2.5 for the 3-point scale models and 1.6 for the 5-point scale models. A constant ratio of 1.7 was also obtained for the logit:probit models. Amemiya (1981) had found through trial and error, a proportionality index of 1.6, a result that is frequently cited (Greene 2000). Greene (2000) obtained a ratio closer to 1.7 than 1.6. Bettman (1974) also found the relative sizes of the coefficients to be similar. It is, however, not possible to compare the ratio he found, as he did not present the values. The presence of a constant coefficient ratio between these models suggests the possibility of transformation of one model form into the other.

Within the literature surveyed so far, no study has been conducted to compare the performance of OLS and ordered probit/logit techniques in estimating satisfaction models with the dependent satisfaction variable measured on a 7 (or more)-point scale. It would have been beneficial to see how similar or dissimilar such models would be. An issue that is also not clear from the literature surveyed so far is whether the manner of obtaining the satisfaction values affects the validity of the assumption of continuous interval data for the values. For example, if respondents rate their satisfaction on a scale consisting of a list of ordered categories with number values, would that affect the measurement level of the data differently than if they rated their satisfaction on a blank scale simply anchored at the ends as say, LOW and HIGH? When an ordered list is used, then the rating is discrete in nature and, because of the categorisation, it cannot be said that the numerical differences between any two sets of adjacent categories are necessarily the same. Thus, perhaps in this case, the use of OLS techniques is not justifiable.

However, when there is no ordered list for the respondent to choose from, but just an end-anchored numerical scale (e.g. "Rate your satisfaction on a scale 1-10, where 1 = LOW and 10 = HIGH"), the respondent is essentially awarding a score from within a continuous range of numbers and it is more likely than not that the difference between their score of 4 and their score of 2 is the same as the difference between their score of 4 and their score of 6. Given the default elementary understanding of numbers, there is no reason to believe otherwise. In this second case, it does appear valid to use the OLS method for satisfaction model estimation. Greene (2000, p.876), in describing the theory of the ordered probit technique, states

> *"Consider, for example, an opinion survey. The respondents have their own intensity of feelings which depends on certain measurable factors* $\mathbf{x}$ *and certain unobservable factors* ε*. In principle, they could respond to the questionnaire with their own* y^* *if asked to do so. Given only say five possible answers, they choose the cell that most closely represents their own feelings on the question."*

In his argument, since y^* is unobserved, the linear function $y^* = \boldsymbol{\beta}'\mathbf{x} + \varepsilon$ cannot be directly estimated and thus, he says that there is a need for probability choice modelling such as the ordered probit model.

From this argument, therefore, if respondents are given the opportunity to present their own y* by the provision of a non-categorised scale, they would do so and then, y* would be observed and the linear function $y^* = \boldsymbol{\beta}'\mathbf{x} + \varepsilon$ can be directly estimated. Interestingly, amongst the data examples cited by Greene (2000) as appropriate for ordered probit modelling, there is none that is a rating or a scoring. The opinion survey data he used for his example is described as a ranking using an ordered list of opinions.

There is certainly a difference between a ranking and a rating exercise in terms of the nature of information they generate. (As stated earlier, Ortuzar and Willumsen (2001) make a distinction between ratings and rankings, and suggest different analytical techniques for them.) A rating can be defined as an assessment or classification of something on a scale according to how much or how little of a particular quality it possesses while a ranking can be defined as the position or status held by or allocated to somebody or something relative to others in a particular group. Thus, while ratings give quantity (value), rankings give relational position. Examples of ratings include examination marks or scores and judges' scores at competitions and they are treated as quantitative and interval data. They are added together and they are also averaged.

In this study, the dependent variable, transport satisfaction, is a rating on an end-anchored numerical scale of 1-10, measuring the amount of satisfaction an individual obtains from a transport experience. As this variable is not obtained from the scoring of an ordered list of categories of satisfaction levels, it cannot be said to be ordinal in nature. It must be continuous and interval in nature, given the default understanding that people have of the number system. Thus the use of OLS techniques is appropriate for the development of models for such-measured satisfaction. Therefore, the OLS technique of multiple regression will be used in estimating the attribute satisfaction models.

4.3.2.1 Ordinary Least Squares Regression

Since ordinary least square regression is to be used in estimating the attribute satisfaction models, it is important to review here, its principles and underlying assumptions, the consequences of violating any of the assumptions, means of detecting such violations and possible remedies.

Ordinary least square regression is a method used to estimate the parameters of a model or function. It is primarily used for linear models or models that are at least linear-in-parameters (e.g. $Y = A + BZ$ where $Z = X^3$). It is based on the principle of least squares, which seeks to minimize the sum of the squares of residuals i.e. the difference between the actual and the estimated values of the dependent variable of the function (Gujarati, 1992). In OLS, the dependent variable is required to be at the continuous, interval measurement level, while the independent or explanatory variables can be at ratio, interval or ordinal measurement levels. Nominal data have to be introduced in the model as dummy variables. Another required characteristic of the dependent variable is that it should follow the normal distribution. However, non-normally distributed dependent variables can be transformed by conversion to their log form and used.

Ordinary Least Squares produces Best Linear Unbiased Estimators (BLUE) (Bowers, 1991). The estimated parameters indicate the amount by which the dependent variable changes given a unit change in the independent or explanatory variable of interest with the other explanatory variables held constant. The goodness of fit of the estimated function, i.e. the amount of variation in the dependent variable that the explanatory variables explain, is indicated by the multiple coefficient of determination R^2. It has been found that as the number of explanatory variables increase, R^2 increases, so to adjust for the degree of freedom, R^2 is adjusted and the adjusted R^2 ($R^2{}_{adj}$) can be used as a measure of the goodness of fit of the model. The adjusted R^2 can also be used to compare models with the same dependent variable (in the same form). The validity of the model (with respect to the given dataset) is indicated by the significance or otherwise of the F-value, which is the ratio of the explained variance to the unexplained variance.

Ordinary Linear Regression is based on several assumptions, the violation of which can result in erroneous model outputs. The assumptions (Bowers, 1991) are as follows:

1. The dependent variable is a stochastic linear function of the independent variables X_2, X_3 ..... X_k of the form: $Y = A_1 + A_2X_2 + ... A_kX_k + u_1$.
2. The disturbance term u_i is a normally distributed random variable.
3. The mean of u is zero i.e. $E(u_i) = 0$.
4. The variance of u is a constant i.e. $var(u_i) = E(u_i^2) = \sigma^2$.
5. The u_i s are independent i.e. $E(u_i\, u_j) = 0$, $i \neq j$.
6. The independent variables X_2, X_3 ..... X_k are non-stochastic variables, fixed in repeated samples.
7. There is no exact linear relationship between any of the independent variables.

Violation of Assumption 1 i.e. incorrectly specified model will produce biased and inconsistent estimators. A non-random distribution of the u_is around the regression line indicates this. Violation of Assumption 2 would still produce best linear unbiased estimates that are consistent, but may not be asymptotically efficient. Also, in small samples, tests of significance of regression of regression parameters may be unreliable. Normality of u can be checked for by inspection of the residual log plot or the range of the standardised residuals – 75% of the values should lie between –2 and +2. (Bowers, 1991) Violation of Assumption 3 would still produce best linear unbiased estimates except that the estimate of the constant would be biased which is not a serious issue. (Bowers, 1991).

Violation of Assumption 4 i.e. the occurrence of heteroscedasticity produces linear unbiased estimates but not the best. While the estimators are still consistent, they are no longer asymptotically efficient. The estimated variances are biased and therefore hypothesis testing is affected. Thus non-significant variables could be accepted as significant. Heteroscedasticity can be detected by graphical methods (inspection of the pattern of distribution of the residuals when plotted against the independent variables). Transforming the model by dividing through by either $\sqrt{X_i}$ or X_i, where X_i is the suspected variable that variance is related to, before applying OLS would correct heteroscedasticity. Violation of Assumption 5 i.e. the occurrence of autocorrelation results in consistent linear unbiased estimates that are neither best nor asymptotically efficient. As in heteroscedasticity, estimated variances are biased and thus interval estimates and hypothesis testing could be misleading. Autocorrelation, which relates to time series data, can be detected by graphical methods and the Durbin-Watson test. The remedy is to transform the data to eliminate autocorrelation and then apply OLS (Bowers, 1991).

Violation of Assumption 6 occurs when the independent variables take random values and/or vary from sample to sample. When the independent variables vary from sample to sample, there is no effect on OLS estimation or on statistical inference processes. Violation of non-stochastic nature of independent variables is common in most social science research, where it is not possible to know the X_i beforehand. Thus a random and large sample is collected with the hope of collecting all relevant X_is. However, this violation is only problematic if the independent variables are related to the error terms U_i. The consequences of the violation depends on whether (1) Xj and Ui are independent; (2) Xj and Ui are contemporaneously uncorrelated; (3) Xj and Ui are neither independent nor contemporaneously uncorrelated. In case 1, there is no problem and OLS produces "BEST" Linear Unbiased Estimates (BLUE). In case 2, OLS does not produce BLUE, but the estimates are still consistent, asymptotically unbiased and asymptotically efficient. In case 3, OLS estimates are neither BLUE nor consistent, asymptotically unbiased and asymptotically efficient. There is no method of detecting this violation and hence there is no remedy other than ensuring a correct theoretical basis for a model where U_i and X_j are unlikely to be related. (Bowers, 1991).

Violation of Assumption 7 occurs when the independent variables X_is are related i.e. multicollinearity. The relationship could be exact or not. When exact, perfect multicollinearity occurs and the OLS process fails. When the relationship is not exact, strictly speaking, this assumption is not violated, however, the model does suffer from some degree of multicollinearity. In the presence of some form of multicollinearity, OLS estimators are still BLUE, consistent and asymptotically unbiased and efficient. However, variance size is affected especially as the degree of multicollinearity increases. Thus the estimators are more imprecise and there is a high unreliability of parameter estimate value. Statistical inference is also affected and significant variables could be falsely indicated as insignificant. Symptoms of multicollinearity include a regression equation with a high R^2 value, but for which few if any of the variables are significant. Remedy is to determine the highly correlating variables and remove one or the other of them. But this is subject to the condition that theoretically relevant variable should not be excluded or else, the omitted variable error of under-specified model would occur. (Bowers, 1991). However as Gujarati (1992) has indicated, multicollinearity does not hinder performance of predictive models.

The above review has been necessary to ensure that in estimating the attribute satisfaction models, care is taken to maintain the principles and assumptions of the OLS technique, and to remedy any assumption violation. In the following sections, issues pertinent to modelling the overall transport satisfaction will be considered.

4.3.3 Overall Satisfaction Modelling

Several approaches that have been used to derive judgement or perception models will be considered here. Costantino et al (1974) found that overall satisfaction could be explained in terms of attribute satisfaction through the use of linear additive models. They measured overall modal satisfaction and individual attribute satisfaction on a 7-point semantic differential scale and used a multiple regression approach similar to the cognitive summation theories advanced in the field of psychology (see Fishbein, 1967 and Rosenberg, 1956) to estimate the models. Wilkie and Pessemier (1973) summarised the differentiating issues involved in the versions of these theories in use in the marketing research field. Satisfaction being a feeling could be considered as a state of mind and hence as an attitude. In this case, the theories of attitude summation could be applied to overall satisfaction modelling.

Cooksey (1996) describes a process called Judgement Analysis that externalises an individual's judgement policy by using statistical methods to derive algebraic models of the judgements made in reference to a large number of actual or simulated combinations of the factors and levels. Judgement Analysis is currently used as a term to describe methods that employ multiple regression equations to model human judgement (Cooksey, 1996, pp xi). These methods include Social Judgement Theory and Policy Capturing (Cooksey, 1996). Judgement analysis differs from other decision approaches such as Decision theory, Behavioural Decision Theory and Information Integration Theory in several ways. Its mathematical basis rests in multiple correlation/regression statistics while others are based either on probability theory, utility theory or analysis of variance. Another difference is that while most other methods analyse judgements before they are actually made (i.e. *a priori decomposition* of the process), judgement analysis examines decisions after they are made (i.e. *a posteriori decomposition* of the process) (Cooksey, 1996).

The judgement analysis method consists of presenting a judge or judges with a series of **N** profiles of cue values (or **N** scenarios i.e. combinations of certain attributes of the system with varying levels), and requiring them to make a judgement for each profile. Analysis is conducted on an individual judge basis and the data set would consist of a matrix of the suitably quantified cue (attribute) values $[\mathbf{X_1}, \mathbf{X_2}, \ldots \mathbf{X_N}]$, considered by each judge and a vector of his or her judgements, $[\mathbf{Y}]$. This data array is used to capture the judge's policy using multiple regression. The goal of capturing the policy is to produce a linear equation, $[\mathbf{Y}] = [\mathbf{X_1}, \mathbf{X_2}, \ldots \mathbf{X_N}]$, that optimally weights each cue (attribute) in terms of its predictive contribution to the judgements. The process of multiple regression ensures that the best fitting linear model is constructed on the basis of the available data. This model can then be used to predict judgement values that can be correlated with the actual judgements to produce a measure of goodness of fit of the model (Cooksey, 1996).

Information integration theory, which was developed by Anderson (1968, 1974), seeks to uncover the subjective rules by which multiple attributes are combined or integrated in evaluations, or to determine human judgements and decisions. Information integration involves two stages: a subjective function that transforms objective to subjectively perceived attributes and an integration function that combines the attributes into an overall evaluation. For choice modelling, a further function can relate the evaluation to the behaviour (Pipkin, 1986). The basic assumption of the information integration approach is that when a number of different factors are to be taken into account when making a judgement, each factor can be represented by two parameters: a scale value corresponding to the subjective evaluation of the factor along the dimension of judgement (e.g. the satisfaction level of the comfort attribute of the service) and a weight representing the importance of the information for the judgement to be made.

Thus, information integration entails two basic operations: valuation and integration (Eagly and Chaiken, 1993, pp 241). Valuation is the determination of the two aspects of information on the attribute of interest: its scale value and its weight. Integration is the process of combining the information on all the attributes. Information integration assumes that the integrated judgement is represented by an algebraic function of the weights and scale values of the various attributes. Information Integration employs such cognitive integration rules as adding, averaging and multiplying. Thus several algebraic functions are applied to the explanatory attributes and the various outputs are compared to the original data output for best fit or agreement.

The information integration method has had a history of success in describing complex cognitive processes, including transportation judgements (e.g. Levin et al, 1977); travel decisions, clothing shopping, and recreational trail management (Pipkin, 1986, pp194); and attitude formation (Eagly and Chaiken, 1993). It has also been used to examine phenomena such as attitude change, impression formation and causal attributions (Cooksey, 1996, pp 31). It has been used in measuring attitudes towards both objective and subjective transport attributes like travel time, cost, comfort, convenience, safety, etc (e.g. Levin, 1977).

The descriptive models of information integration theory (Anderson, 1974) have proved useful in evaluating how numerical information is perceived, integrated and used in making decisions. Information integration theory differs from the judgement analysis techniques as it combines a psychophysical theory of measurement "functional measurement" with a theory of information integration "cognitive algebra" to produce a coherent expression of the subjective nature of the human judgement (Cooksey, 1996, pp 31). Using factorial analysis of variance, scale values and weights are determined for each stimulus and then the scale values and weights are multiplied together and then integrated using a specific integration rule. However, factorial analysis of variance is not the only means of obtaining scale values and weights. Eagly and Chaiken (1993, p.256) states:

> *"Although the Information Integration approach suggests that weights would best be assessed through functional measurement, other researchers have explored various methods of directly assessing the weights attached to the attributes .... (e.g. by ratings of the importance of attributes)."*

Anderson (1981, p.36-37) also found ratings of the dimension of interest to be a valid means of obtaining scale values.

The information integration approach is quite similar to the attitude summation theory of Fishbein (1967) except that whereas Fishbein's theory assumes that the combination rule is a weighted summation, information integration theory tests several possible combination rules and settles for that which provides the closest fit to the original data. For instance, based on their long-term research program, Anderson and his team (Anderson, 1981), conclude that the weighted averaging rule is the most representative of most judgement processes. Eagly and Chaiken (1993) in comparing the information integration approach and the attitude summation theories of Fishbein, suggest that the two approaches also differ in their scope; Information Integration being broader and applicable to more issues than just attitude summation. They also state in page 256:

> *"In head-to-head competition between the expectancy-value rule of the attitude summation theories and the weighted averaging rule typically used in information integration contexts, the weighted averaging model has generally proven superior".*

Information Integration proposes that stimuli responses are integrated according to rules and can be fitted by simple algebraic models. Thus it is able to accommodate every possible stimulus and does not require that users be homogeneous in their preferred attributes. It also has provision for user-stated weights to be applied to the attributes, which permits further the tailoring of the function to the specifications of the individual user. Information Integration theory being based on combination rules and by including user-stated importance values offers some possibilities to support the approach required in this study, which in developing an individual user satisfaction prediction model, requires a function that can be tailored to fit an individual user. Levin (1977) has stated that the models of Anderson's information integration theory are ideally suited to transportation problems that involve describing how system and user characteristics combine to influence modal choice. Thus they could similarly be suitable for describing how system and user characteristics combine to influence transport satisfaction.

For a multi-attribute service such as transport, when user preferences about abstract travel attributes are being considered, it is important to have the flexibility to consider all attributes uniquely relevant to individual users; and also to be able to input in the model functions, weights that are unique to the individual. This requirement necessitates the development of a relatively 'open-ended' function that permits the inclusion of any number (and type) of attributes that is relevant and important to the individual user. As long ago as 1976, Recker and Golob considered that calibrating a model with alternative attributes accomplished an improved flexibility over single-equation models such as those derived by regression techniques in addressing planning policy issues. The flexibility was that the models were developed as open-ended so that relevant attributes and their characteristics could be inserted to represent the specific situation. The analogy here is that the model being open-ended would enable the attributes relevant to any one user to be inserted when a satisfaction value is to be predicted for that user. Thus the models are like a system of equations where the variables are not fixed in number or type, but rather the operations (i.e. add, divide, subtract, or multiply) on them are fixed. So the variables are like boxes into which values specific to a user can be inserted and because only the operations are fixed and not the number of variables, the model can accommodate both the user who holds preference for only two attributes and the user who has preferences for ten attributes.

More recently, USDOT (2003) reports, in a qualitative study to identify factors affecting customer satisfaction with roadway facilities, that drivers used different subjective measures for expressing their level of satisfaction. While some used the number of traffic lights they had to sit through, others used the length of the traffic backup. The report recommends that future quantitative surveys need to make provision for this. Essentially therefore, the fact that for different people/users, different attributes of a system influence their overall perception of the system means that every known attribute of the system should be represented in a model for the system. The contribution, or not, of any one attribute towards the model output would then be a function of a particular user's preferences. This present study takes such an approach. From the literature reviewed, no other study has taken such an approach especially with reference to transport satisfaction.

Thus, regression and regression-type techniques may not be suitable for the development of the overall satisfaction model (i.e. the function F in Section 3.3.2 above). This is because whereas in this study, it is desired that the selection of significant or insignificant attribute should be based on the individual user's preferences, regression-type techniques encourage the selection of some 'significant' attributes for inclusion in the model and the exclusion of others based on an averaging over all respondents in the data being analysed. Also, the weighting (i.e. coefficient) for any attribute is dependent on its average importance value over the sample rather than its importance value to any one particular user. While the average user may describe the sample, it may or may not describe any single respondent. In addition, the use of regression-based techniques may be unsuitable in multi-attribute systems like transport, where multicollinearity is not unexpected, as performance in certain attributes could and do correlate highly with other attributes' performances.

Primarily, the objective of function F in Section 3.3.2 above is to show how all the individual attribute satisfaction values come together to form the overall satisfaction. Essentially both sides of the equation consist of the same item type. As Wilkie and Pessemier (1973) quoted: "Affect $= f$ (affect) is not much of a model", similarly to attempt to estimate a model that predicts satisfaction from satisfaction does seem excessive and unnecessary when all that is needed is a knowledge of how the attributes combine – whether in a compensatory or a non-compensatory manner. This is especially so when there is a requirement that every attribute should be represented in the relationship and none eliminated on the basis of sample mean insignificance. For this reason, Anderson's method of determining this combination rule seems more appropriate to the task.

It could be argued that a regression technique where all the variables are forced in could also achieve this, but then for the non-significant variables, the values of their coefficients would serve to reduce their influence on the overall satisfaction value. Again, let it be re-emphasised that the issue in this study is to put the decision-making in the power of the user rather than leave it to the assessment of either the broker, the modeller or the forces of statistical averaging. It could also be asked that as there is potentially an infinite number of rules that could be used in attribute satisfaction combination, how would the optimum rule be determined? In determining an appropriate combination rule, resort can be made to the results of the studies conducted by Anderson and his team over a period of time (Anderson, 1981). From their research programme, they conclude that while behavioural measures are often non-linear in combination, judgemental measures are mainly linear. Thus, the number of potential rules to be investigated is narrowed down.

The issues (see Section 4.2.1) presently challenging the assumption of rationality in choice modelling and decision-making modelling also come to mind at this stage. The basis of bounded rationality is that people do not optimise in decision-making, but rather they satisfice i.e. they search until they find an option that meets some threshold requirement for them (Gigerenzer and Selten, 2001). People do this to avoid the search costs (cognitive and memory-wise) of assessing information on all attributes of all alternatives and comparing them. In the same way, considering that a model is a "satisficing" representative of a system, the cost of deriving an optimum model may be unnecessary if a sufficiently suitable model could be derived at lesser cost. Anderson (1974a) also acknowledges the issues of "satisficing" by providing for the discounting of attributes considered by the subject not to be relevant to the judgement process or those attributes the subject ignores in his or her avoidance of high search costs. Such discounted attributes acquire zero weight even while maintaining their scale values.

In this study, therefore, the information integration approach will be used to determine the combination function F. Basically, the information integration theory supposes that if a person has or receives a set of stimuli or pieces of information from which he or she is to reach a judgement; that judgement can be assumed to be a linear function of the value of the items, i.e. $\mathbf{J = C + \Sigma w_i s_i + \varepsilon}$; where J is the judgment; C is a constant term; w_i and s_i are respectively, the scale value and weight of the i^{th} term in the set; and ε is a random error term with zero mean and represents judgement variability (Anderson, 1968). For an averaging process, the weights are required to sum to unity making the middle term $\mathbf{\Sigma w_i s_i}$ to be $\mathbf{(\Sigma w_i s_i / \Sigma w_i)}$, whereas for a multiplying process the middle term would be $\mathbf{\Pi s_i}$ which is the product of the various scale values of the items (Anderson, 1974b). Anderson (1974a) emphasizes that these models are descriptive and that they imply that the subject judges "**as if**" they were averaging or adding or multiplying (whichever combination process the task is considered to follow). In Anderson (1981), the following combination rules are prescribed:

1. Adding: $J = (\Sigma w_i s_i)$
2. Subtracting: $J_{ij} = (s_i - s_j)$
3. Averaging: $J = (\Sigma w_i s_i / \Sigma w_i)$
4. Multiplying: $J = (\Pi\, s_i)$
5. Dividing: $J = (s_j / s_k$ or $s_1/(s_2 + s_3))$
6. Adding-Multiplying: $J = (w_1 s_1 + w_{23} s_2 s_3)$

Anderson (1974a,b) states and provides examples to the effect that adding models arise in, and can be used for, spatial and temporal summation; subtracting models can be used for preference and difference judgements; averaging models arise in, and can be used for, bisection and contrast effects, size-weight illusion, perceptual tasks, psychophysical integration and attitude change; multiplying models arise in traditional utility theory and can also be used for size constancy; while dividing models arise in, and can be used for, ratio settings and comparative judgements.

Intuitively, the averaging rule seems more relevant to this study because it provides a sense of net compensatory effect of the satisfactions due to the individual attributes. The impact of the satisfaction of any one attribute towards overall satisfaction is affected not only by its own importance but also by the importance and value of the other attributes it is combined with. The adding and multiplying rules provide a sense of a cumulative effect i.e. 'the more attributes the better': which is not necessarily the case. Satisfaction with a very good transport service could be reduced by the inclusion of a new attribute with a high unsatisfactory value to the users. For example, the introduction of armed air marshals in aircrafts may not necessarily increase air travellers' satisfaction levels for the service. The dividing and the adding-multiplying rules require prior knowledge of specific attribute interactions. Such knowledge is not available. Thus for this study, the averaging rule appears the most appropriate rule.

4.4 TRANSPORT ATTRIBUTES

4.4.1 Introduction

A transport satisfaction model requires as data input, information on both the attributes and characteristics of the transport system and the characteristics of the transport user. The relevant and available user characteristics to be used in the model have been indicated in the proposed model in Section 3.3.2. The relevant transport system attributes to be included in the model will determined from the review of transport attributes to be considered in this section.

The first step in satisfaction analysis is to identify the important attributes of the service or product (Oliver 1981; Ajzen and Fishbein 1973, 1977). Most studies in transport have considered transport attributes with respect to transport modal choices. However, the attributes of a service that influence choice may not necessarily be the same attributes that influence satisfaction formation, though it must be said that it is not impossible that some of the travel attributes that influence satisfaction formation are same as some of the ones that influence choice. This is because customer loyalty, which satisfaction influences, is represented by repeated same choices. As stated in Section 4.2.1, whereas choice is made before using the service, satisfaction is realized after experiencing the service. Thus the main factors influencing choice would relate to user objectives, limitations and constraints – issues of destinations, time and cost. The main factors influencing satisfaction would relate more to user needs and desires – issues such as comfort, convenience, reliability etc (i.e. attitudinal attributes). The factors that influence user satisfaction are generally the same factors that influence service quality assessment (McDougall and Levesque, 2000, p.394). Thus these factors also tend to be related to the performance of the service. However, the attributes considered as relevant to users must reflect their views of service performance and not the service providers' view of service performance (as discussed in Section 2.4).

Previously, performance measures for organisations used to be related to service or goods production efficiency (TRB, 2000). But the new paradigm discussed in Chapter 2 proposes and uses performance measures related to the experience of the customer. For instance, in the parcel courier industry, in addition to service-based (or production efficiency) performance measures such as Cost Per Stop, Cost Per Delivery, Number of Deliveries, Send-Agains, and Time Per Delivery; user-based (perceived) performance measures such as % On Time Delivery, Door-To-Door (D-2-D) Reliability, D-2-D Time, D-2-D Cost, Market Share and Customer Satisfaction are imposed as an evaluation level for overall system performance (TRB, 2000). However, the new paradigm does not advocate the replacement of system measures with user measures, but rather a combination of both for overall performance measurement, recognizing that these two types of performance attributes are distinct and that both are important and appropriate at different scales. The application and operationalisation of this new thinking in transport is limited by the non-availability of appropriate tools and decision systems. This study hopes to address this by the development of a transport satisfaction prediction model.

4.4.2 Review of Literature

The literature is replete with studies (to be reviewed below) listing the travel attributes considered important and relevant by different groups of transport users including the elderly, the disabled and the young in meeting their transport needs and desires.

Attributes relevant to non-specified user groups are also indicated in the literature. This section summarises the output of some of these studies into a comprehensive list of travel attributes for use in the development of the proposed transport-user satisfaction model. From the literature surveyed, two types of attributes are evident: those that can be referred to as attribute dimensions which are not directly measured or observed, but rather can be represented by other observable and measurable attributes; and the observable and measurable attributes.

TRB (2000) reports that in London, user-perceived performance measures of 20 factors were summarised in 6 general areas – Cleanliness; Condition of the bus & bus stop; Information; Staff; Service; and Personal Safety while the production efficiency measures included Mileage operated; Regularity of high frequency services; Punctuality of low frequency services; Schedule adherence; Excess waiting time and Delay due to external causes. In their study (in USA) of public transport consumer preferences, Costantino et al (1974) considered as relevant these twelve attributes: Wait Time, Travel Time, Fare, Comfort, Automatic Control, Amount Of Privacy, Arriving On Time, Safe From Harm, Room For Strollers, Able To Get To Places, Refreshments And Temperature Control. Thus it does appear that user-perceived measures of travel do not differ much between the UK and the USA.

Sussman (2000) listed the following as the relevant transportation level of service variables (attributes) for transportation users: Average Trip Time, Trip Time Reliability, Value of Time, Cost, Service Frequency, Waiting Time, Comfort, Safety and Security, and other Intangibles such as Status for private car users. He relates Comfort to air-conditioning on the bus, being able to listen to ones' favourite music while travelling, and edible food on the train. In this work, Safety refers to the probabilities of accidents and their consequences, while Security refers to car-jacking or being mugged on a public transportation system.

In Pullen (1992), the following sixteen attributes of travel were considered important and relevant by respondents: Service Frequency, Destination Choice, Using Discounted Tickets, Fares, Journey Speed, Reliability, Convenience, Crew Helpfulness, Getting First Bus, Getting Seat, Comfort, Time Information, Route Information, Ticket Information, Cleanliness and Security Capacity. DETR (2001) specifies the following as the main issues of concern to older people: Safety, Accessibility, Affordability and Availability. A report by Help the Aged (1998b) states that for the elderly, the top four issues are Safety, Accessibility, Reliability and Affordability. Many of the issues associated with providing accessible transport for older people are also pertinent to many other members of society such as young people, people with small children and/or pushchairs and travellers with baggage. DETR (1999b) reports that for young people, the following attributes affect their satisfaction with transport: Availability, Frequency, Reliability, Cleanliness, Comfort and Information. In addition, the young people expressed much higher concern (than older people) about Travel Cost, Transport Staff Attitude and Availability of Night and Weekend Services.

It is worth noting that for different transport modes, travel attributes identified by passengers are quite similar (making provision for those attributes that are specific to the form of travel). This suggests that people basically watch out for the same attributes irrespective of the mode by which they travel. These attributes could thus be considered as the needs/desires of transport users thus, they impinge on the consciousness of the users. There has been quite close similarity of travel attributes for air-travellers as for car users and for transit users. For instance, Hodgson et al (1997) considered the following as important attributes in people's comparison of cars with buses: Convenience, Reliability, Journey duration, Safety and security, Comfort, Expense and Environmental effect. Also, Seneviratne and Martel (1994) in evaluating quality of service at air terminals used five passenger-identified characteristics of the terminal of a transport mode (Air). These characteristics: Availability of Seats, Walking Distance, Accessibility, Orientation (i.e. availability of information) and Waiting Time are commonly cited as important by land-based transport modes.

In their development of a user-based measure of service quality, Prioni and Hensher (2000) selected, from some forty attributes they identified in the literature, thirteen attributes they felt described the major dimensions of service quality from a user's perspective. The thirteen attributes were Reliability, Fare, Walking Distance to the Bus-stop, Waiting Safety, Travel Time, Bus-stop Facilities, Air-conditioning, Information at the Stops, Frequency, Safety on Board, Cleanliness of Seats, Access to the bus, and Driver Attitude. In a study comparing express bus service users and local bus service users with respect to their importance and satisfaction ratings for travel attributes, Forte and Stuart (1998) used ten travel attributes, six of which had also been identified as important to users in an earlier survey. To these six, they added attributes related to the higher speeds of the express service and to the hours of service provided. The ten attributes were Safety from crime; Reach destination quickly, On-time at stop; Frequency of buses; Cost of service; Available seat; Time service ends (evening); Time service begins (morning); Driver courtesy; and Air temperature on vehicle.

In devising a marketing plan for mass transit, Vanier and Wotruba (1977) interviewed some 200 bus-rider households and approximately 200 non-rider households in the U.S.A. and generated information on transit attributes (variables) relevant to the transit needs of both groups. The selected attributes and their component characteristics are as follows:

- **Bus Stops** – How well located; How easy to recognise; How safe; How well protected from weather; How easy to get to.
- **Schedule Frequency** – Weekday rush hour; Weekday non-rush; Weekday nights; Weekend days; Weekend nights.
- **Bus Routes** – How directly the bus goes to destinations; Travel Speed of the bus; Types of areas the routes go through; How close the bus comes to your destinations.
- **Transfers** – Waiting time at transfer locations; Convenient locations of transfer points; Safety of locations; Ease of getting from bus to transfer locations; Ease of obtaining transfers; Driver cooperation in accepting transfers.
- **Buses and Ride** – Colour of bus; Ease of entry and exit; Cleanliness of bus; Temperature inside bus; Comfort of bus; Availability of seats; Smell on the bus; Ease of movement inside; Quietness of bus ride; Smoothness of bus ride; Personal Security on the bus, Noise made by the bus; Travel safety.
- **Fares** – Price.
- **Drivers** – Personal appearance; Traffic safety; Courtesy; Helpfulness; Willingness to wait; Ability to run on time; Ability to handle bus smoothly.

Swanson and Ampt (1997) in measuring bus passenger preferences, by interviewing bus riders, grouped the attributes they had obtained into journey phases. However, their final selection was limited to those attributes for which the operators (London Transport Buses) considered that they had some control and could influence. The attributes they finally selected were as follows:

- **Pre-trip information** – Maps; Timetables; Customised local information; Telephone information services.
- **The bus-stop infrastructure** – Type of shelter; Type of seat; Lighting; Cleanliness and state of repair.
- **Waiting at the bus-stop** – Fixed information display; Real-time information; Service reliability.
- **The bus at the kerbside** – Compulsory or request stop; Ease of identifying correct bus; Stopping position of bus; Design of vehicle entry steps.
- **Encountering the driver** – Driver appearance; Driver helpfulness; Driver identification; Availability of change.
- **Moving to your seat** – Level of crowding; Design of luggage storage area; Seating configuration; Quality of vehicle motion.
- **Travelling in a seat** – Types of seats; Spaciousness of seats; Type of ventilation; Cleanliness; Travel time.
- **Leaving the bus** – provision of information on the bus; Number and location of doors.

In a study on user perception of public transport level of service in Santiago, Chile, Ortuzar et al (1997) derived the following 12 attributes after a Delphi-type survey (anonymous solicitation and comparison of the views of experts) of public-transport specialists and a 'semi-' focus group survey: Accident risk; Alternative use of time while travelling; Bus driver appearance and behaviour; Bus occupancy; In-vehicle travel time; Possibility of travelling seated; Travel Cost; Variability of travel time; Variability of waiting time; Vehicle Comfort (seat quality and spacing, dirt, noise, etc); Waiting Time and Walking Time.

In an attempt to develop a segmentation model for mass transit marketing, Gensch and Torres (1980) considered 19 attributes of travel. The attributes are as follows:

1. Comfort
2. Convenience
3. Cost
4. Package Space
5. Ease of use
6. Reliability
7. On time
8. Rush hour travel time
9. Safety
10. Violence
11. Ease to destination after leaving vehicle
12. Crowding
13. Wait time
14. Relaxation
15. Weather exposure
16. Waiting in traffic
17. Flexible schedule
18. Extra time
19. Parking cost.

In a study analysing consumer preferences for a public transportation system, Golob et al (1972) extracted 91 transport system characteristics by 'literature search and professional experience'. Of these system characteristics, thirty-two (32) were selected for investigation and they are as follows:

1. A shorter time spent travelling in the vehicle
2. A shorter time spent waiting to be picked up
3. Arriving at your destination when you had planned to
4. Ability to adjust the amount of light, air, heat and sound around you in the vehicle
5. More space for storing your packages while travelling
6. A stylish vehicle interior
7. Freedom to turn, tilt or make other adjustments to your seat

8. The availability of coffee, newspapers and magazines in the vehicle
9. Same variation in travel time from one day to the next
10. More phones available in public places used to call for service
11. More protection from the weather at public pick-up points
12. More chance of riding in privacy
13. More chance of meeting people in the vehicle
14. More chance of being able to arrange ahead of time to meet and sit with someone you know
15. More chance of rearranging the seats inside the vehicle to make talking with others easier
16. A lower fare for passengers
17. Making a trip without vehicles
18. Less time spent walking to a pick-up point
19. Being able to select the time when you will be picked up
20. Longer hours of available service
21. A vehicle whose size and appearance do not detract from the character of neighbourhood through which it passes
22. Calling for service without being delayed
23. Being able to talk to, and ask questions of, systems representatives when desired
24. Easier entry and exit from the vehicle
25. Room for accommodating baby carriages, strollers and wheel chairs in the vehicle
26. The assurance of getting a seat
27. Less chance of meeting with people who make you feel insecure or uncomfortable
28. More room between you and others in the vehicle
29. Being able to take a direct route with fewer turns and detours
30. Being able to take routes which are pleasant or scenic
31. More chance of riding with different kinds of people
32. Convenient method of paying your fare

Golob and Recker (1977) in a study developing a procedure for predicting travellers' mode choice using attitudinal data, list 25 attributes they consider appropriate. The attributes are as follows:

1. Comfortable seating
2. Dependability of on-time arrival
3. Availability more or less when you want it
4. Attractiveness of vehicle
5. Low noise level in the vehicle
6. Vehicle safety
7. Smoothness of ride
8. Privacy from other people
9. Avoiding exposure to traffic congestion
10. Minimum exposure to bodily crowding
11. Low out-of-pocket cost
12. Low riding time
13. Low walking time
14. Low waiting time
15. Opportunity to meet and talk with other people
16. Opportunity to relax
17. Opportunity to read
18. Continuous ride, few stops
19. Protection from weather on entire trip
20. Flexible destination, can go anywhere
21. Not having to change vehicles
22. Year-round temperature comfort in vehicle
23. Assurance of having a seat
24. Security from undesirable acts of others
25. Minimum pollution per person carried

These attributes are quite similar to those listed by other researchers with respect to transport satisfaction and/or transport service quality. This suggests that, perhaps, choice and satisfaction do not really differ so much in the attributes that influence them.

Koppelman and Pas (1980) also identified 24 attributes by 'review of literature, qualitative research and questionnaire pre-testing' for use in developing travel choice behaviour models. The attributes are as follows:

1. On time
2. No trip scheduling necessary
3. Relaxing
4. Correct temperature
5. No worry of assault
6. Can come and go at will
7. Errands take little time
8. No worry of injury
9. Know how to get around
10. Little effort involved
11. Available when needed
12. Not made uncomfortable by others
13. No problems in bad weather
14. Pleasant personnel
15. Get to destination quickly
16. Protected from smoking
17. Safe at night
18. Not annoyed by others
19. No long waits
20. Easily carry packages
21. Easy to travel with children
22. Not tiring
23. Easy getting in and out
24. Easy walk access

Similarly, Spear (1976) proposed and investigated the use of a concept 'Convenience' as a variable for inclusion in a model of mode choice behaviour. He found the goodness-of-fit of the model was improved by the inclusion. He derived 'Convenience' as a generalized attribute equivalent to the summation of the individual's sensitivity-weighted perceived satisfaction with 14 sub-attributes. The sub-attributes were:

1. Arrive at the intended time
2. Able to travel in all weather
3. Avoid a long wait

4. Avoid leaving early for work
5. Have the vehicle easily accessible form home
6. Avoid numerous stops
7. Have a choice of departure times
8. Have understandable maps and schedules
9. Pay as little as possible for the trip
10. Travel in the shortest time
11. Avoid a long walk
12. Avoid changing vehicles
13. Avoid paying daily for the trip
14. Avoid undesirable areas.

However, he acknowledged that his research had not addressed the relationship between individual satisfactions with the sub-attributes and the physical characteristics of the transportation system on which the satisfactions were based. This study intends to investigate such relationships.

TRB (1999c) lists the following as the seven dimensions of customer service quality required to satisfy transit customer needs: Reliable; Safe/Secure; Convenient/Accessible; Comfortable/Clean; Understandable/Intelligible; Affordable; and Empathetic.

Reliability has to do with on-time arrival of vehicles either for pick-ups or drop-offs. Safety and security involves, minimizing accidents on vehicles and in facilities, and minimizing risks to passengers from the time they arrive at a boarding area until they reach their destinations. In addition to feeling safe when on board the vehicle, passengers must also feel safe at transfer stations, bus stops, and other pick-up and drop-off locations. TRB (1999c) also states that passengers feel safer in clean, well-lit vehicles and facilities, as they perceive that someone is in charge.

Convenience involves serving not only locations where customers live, but also where they need to go as well as providing service at the times and during the days when customers need to travel. Convenience also means scheduling transfers between vehicles or between different modes so customers can go directly from an incoming vehicle to their outbound vehicle without waiting. Another key component of a convenient transport system is easy access to information.

TRB (1999c) states that customers deserve a comfortable and clean environment at all times, whether they are on board a vehicle, in a facility, or at a stop. Employees also need a comfortable and clean work environment in order to deliver the best possible service to your customers. Bus stops, transfer stations, and other pick-up and drop-off points should provide adequate seating and waiting areas that are both comfortable and clean. Drivers and other personnel should be clean and appropriately groomed when they are at work to instil comfort and confidence in their customers.

Understandability/intelligibility means that all customers can easily and quickly learn how to use the transit system (TRB, 1999c). Current passengers (including occasional passengers), potential passengers, and the community should be able to easily understand how to access the service, how to pay, and how to conduct themselves in accordance with system policies. Route schedules and information about the service, including stop times and locations, and making a reservation, need to be easily accessible to customers and visitors (TRB, 1999c). The transport service system should not only be a convenient transportation option for users, it should also be an affordable option.

TRB (1999a) also provides a list of 48 transit attributes from a much longer list summarising the service attributes defined by transit users in focus group discussions. These 48 attributes were obtained after reviewing the original list to eliminate duplications and refine words for clarity. Their definitions are quite self-explanatory and the list is reproduced below.

1. Absence of graffiti
2. Absence of offensive odours
3. Accessibility of trains/buses to handicapped
4. Availability of handrails or grab bars on trains/buses
5. Availability of monthly discount passes
6. Availability of schedule information by phone/mail
7. Availability of schedules/maps at stations/stops
8. Availability of seats on train/bus

9. Availability of shelter and benches at stations/stops
10. Cleanliness of interior, seats, windows
11. Cleanliness of stations/stops
12. Cleanliness of train/bus exterior
13. Clear and timely announcements of stops
14. Comfort of seats on train/bus
15. Connecting bus services to stations/main bus stops
16. Cost effectiveness, affordability, and value
17. Cost of making transfers
18. Displaying of customer service/complaint number
19. Ease of opening doors when getting on/off train/bus
20. Ease of paying fares, purchasing tokens
21. Explanations and announcements of delays
22. Fairness/consistency of fare structure
23. Freedom from nuisance behaviours of other riders
24. Frequency of delays for breakdowns/emergencies
25. Frequency of service on Saturdays/Sundays
26. Frequent service so that wait times are short
27. Friendly, courteous, quick service from personnel
28. Having station/stop near destination
29. Having station/stop near my home
30. Hours of service during weekdays
31. Number of transfer points outside downtown
32. Physical condition of stations/stops
33. Physical condition of vehicles and infrastructure
34. Posted minutes to next train/bus at stations/stops
35. Quietness of the vehicles and system
36. Reliable trains/buses that come on schedule
37. Route/direction information visible on trains/buses
38. Safe and competent drivers and conductors
39. Safety from crime at stations/stops
40. Safety from crime on trains/buses
41. Short wait time for transfers
42. Signs/information in Spanish as well as English

43. Smoothness of ride and stops
44. Station/stop names visible from train/bus
45. Temperature on train/bus – not hot/cold
46. The train/bus travelling at a safe speed.
47. Trains/buses that are not overcrowded
48. Transit personnel know system/provide information

While useful, this list is limited to the perspective of transit users and does not provide insight to the preferences of other people who may not be transit users, but nevertheless do use other modes of transport. Such groups of people include the mobility impaired who are more likely to use special transport services and people who use private cars and/or non-motorised forms of transport. Their preferences also need to be specifically considered.

In a study (Oregon DoT, 1999) of mobility needs in Oregon, USA, mobility-impaired respondents considered the following travel attributes of public transport to be important in meeting their needs: Safety, Disability-informed Staff, Wheel-chair Space, Ease of reaching Vehicle, Available and Easy to Understand Information, Ease of getting in and out of vehicle, Ease of identifying vehicle, Service Cost, Availability and Ease of Use of Lift unto and off vehicle.

Schlag et al (1996) compiled a list of 38 "mobility related needs" of the elderly as follows:

- Feasibility & Control – Sense of personal control; Availability at every time; Freedom of choice, feeling independent; Spatial availability and accessibility of starting points (distance, stairs); Spatial availability and accessibility of destinations; Spatial availability and accessibility of connections (point to point travel, necessity to change).
- Lack of Strain & Stress – Lack of strain and stress (ease) of obtaining information, user guidance; Lack of strain and stress in access; Lack of strain and stress on the way; Convenience (seat, entering and leaving); Weather protection; Orientation and memory load; Luggage transportation; Psychological distress; anger.
- Time and Costs – Waiting times (incl. Traffic jams); Reliability.

- Social Situation – Security, protection from crime and bother; Privacy (personal space, no crowding); Availability of assistance, help.
- Consequences of Actions – Safety.
- Flexibility and spontaneity (including e.g. reversibility of decisions during travel); Mobility at destination, combination of destinations.
- Lack of strain and stress in planning the trip; Cleanness; Fun, enjoying the travel (Hedonistic value).
- Duration of travel; Time for access, changes; Private costs.

In developing user-based quality of service measures for special service paratransit (i.e. special transport for the elderly and the disabled), Pagano and McKnight (1983) first compiled a list of attributes from a review of literature on both paratransit and fixed route services. To this list they added other attributes based on their own 'observations' and then categorized the attributes into eight dimensions. They further subjected the categorized list to the assessment of a select panel of 22 experts drawn from academia, government and providers. Based on this assessment (which included adding any additional attributes the experts considered important), a final set of attributes under the eight dimensions was drawn up. The final list of attributes and dimensions was as follows:

1. RELIABILITY AND ON-TIME PERFORMANCE
    a. Notification of delays or cancellation of service
    b. Wait time (from time of reservation or schedule) for pickup at home
    c. Wait time (from time of reservation or schedule) for pickup away from home
    d. Arriving at destination on time or within a few minutes of scheduled time
    e. Few delays while on vehicle
2. COMFORT
    a. A guaranteed seat or location for wheelchair
    b. The condition and cleanliness of the vehicle
    c. The smoothness of the ride
    d. Air conditioning and good ventilation
    e. Sheltered waiting areas for pickups away from home

f. Seats in waiting area away from home

3. CONVENIENCE OF MAKING RESERVATION

    a. Accommodation to changes in reservation
    b. Being picked up at times selected by traveller rather than preset times
    c. Shortness of reservation time
    d. Convenience of return reservation procedure

4. EXTENT OF SERVICE

    a. Total number of hours during which service is available
    b. No or few restrictions on where vehicle would go
    c. Service in the evening
    d. Service on weekends
    e. Low rate of turning down reservations because of limited capacity

5. VEHICLE ACCESS

    a. Width of the aisle
    b. Height of the first step
    c. Number of steps
    d. Presence of wheelchair lift or ramp
    e. Assistance in getting from vehicle to destination
    f. Assistance in carrying packages
    g. Short destination from house or destination to vehicle

6. SAFETY

    a. Low probability of personal assault
    b. Low probability of falling
    c. The type of tie down (i.e. wheelchair restraint)
    d. The position of the wheel chair
    e. Safe driver

7. DRIVER CHARACTERISTICS

    a. Ability to handle medical emergencies
    b. Courtesy and friendliness
    c. Knowledge of general needs of elderly and handicapped users
    d. Familiarity with habits and needs of individual user
    e. Neatness and professionalism

8. RESPONSIVENESS TO INDIVIDUAL

a. Courtesy and friendliness of telephone operators
b. Ease of getting clear information on service
c. Receptiveness to complaints and user suggestions
d. Procedure for following up on complaints.

A rider quality index developed for the Swedish Special Transport Services (Knutsson, 1999) lists forty attributes of travel in five groupings as follows:

- **Information** – Information access; Understandable information; Faultless and complete information; and Unambiguous information.
- **Dignity** – Being taken seriously as a traveller; Confidence with respect to what to do and where to go; Personal privacy; Reliability of service; Safety day and night time; Medical emergency capability; Suitable and motivated driver; Courtesy & friendliness; and Familiarity with personal needs.
- **Comfort** – Service on weekdays; Service on weekend; Punctuality, departure; Punctuality, arrival; Freedom from crowding; Booking; Follow-up to complaints; Few restrictions; Pre-booking of return; Smoothness of ride; Vehicle inside design; Number of steps; Space and seating; Lift (or ramp) Distance to vehicle; Driver Assistance; Ease of complaining; and Possibility to choose departure time.
- **Travel Time** – Reasonable in-vehicle time; Waiting time away from home; Waiting time in the telephone switchboard; Total trip time; Delays on vehicle; Pre-booking time; and Punctuality, pick up time.
- **Fare** – Worth its price compared to public transport; and Fare.

It appears that for both transit users and special transport users, there are many common travel attributes of importance and that the few differences in important attributes between them are due to the presence of attributes specifically peculiar to the particular service. For all travellers, Currie (1999) proposes that:

> "*An overall expectation is to travel affordably, in a comfortable and safe way, at the individual's convenience, for the entire trip, from door-to-door*" ;

and

"A common theme running through literature is the need for awareness training of staff to make them more sensitive to the needs of customers and better meet these needs."

From these statements by Currie (1999), the following attributes can be deduced as important and relevant: Cost, Comfort, Safety, Convenience and Helpful Staff.

Comparing the list of travel attributes by Costantino et al (1974), Vanier and Wotruba (1977), Swanson and Ampt (1997) and Prioni and Hensher (2000) with those by Knutsson (1999) and TRB (2000), it appears that while certain attributes are common to both mass transit and demand responsive transport, there are some attributes unique to each. This combination of similarity and uniqueness in relation to relevant attributes also appears to hold between mobility-impaired people and more able people (Oregon DoT, 1999 vs. DETR, 1999a). In the context of transport brokerage, where potentially, any transport type can be recommended, an appropriate transport attribute list should contain both common and unique attributes.

Vanier and Wotruba (1977) grouped travel characteristics in terms of attributes of the transport system; Swanson and Ampt (1997) grouped them in terms of journey stages, while some other studies have grouped similar travel characteristics in terms of user-perceived qualitative measures (e.g. Golob & Recker, 1977, Knutsson, 1999, TRB, 1999a,c). However, Golob et al (1972) classified the transport system characteristics they investigated into three groups: 'vehicle design', 'levels of service' and 'convenience factors'. They consider that 'vehicle design' characteristics are concerned with the 'human environment' aspect of transport, which views the vehicle as an extension of, and a complement to, humans in addressing their physical, functional and behavioural requirements; and includes easier entry and exit, and micro-climate control. They hold that the 'levels of service' characteristics consist of 'quantifiable' characteristics of the system such as travel time, waiting time, and transfer time and the 'convenience factors' are concerned with the existence of service rather than the level of service – e.g. existence of shelters.

There does not appear to be any evidence as to the benefit of one type of grouping over the other. However, intuition seems to suggest that a user-perceived attribute grouping may elicit more in-depth consideration and hence more realistic response from users. Also looking at the list by TRB (1999a), in the context of the other listings, the distinction between customer-defined travel attributes and operator-defined attributes is quite obvious. It does appear that customer-defined attributes are more real to users and thus easier for them to assess or rate. Since the objective of this review of the literature on transport attributes is to determine those attributes that transport users hold relevant to their satisfactory experience of a transport service, such self-explanatory attribute nomenclature would appear more suitable to this study than the more abstractly labelled attributes.

A summary of the attributes cited in the literature reviewed is presented in Table 4.1 below.

Table 4.1 Attributes

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Cleanliness					✓				✓		✓		✓	✓				✓			✓	✓	✓		✓	
Cleanliness of Seats/Bus					✓			✓													✓		✓			
Cleanliness of environment e.g. graffiti																					✓					
Smell on the bus					✓																✓					
Information					✓		✓		✓	✓	✓			✓				✓	✓	✓	✓	✓	✓		✓	
Time Information									✓																	
Route Information									✓																	
Ticket Information									✓																	
Information at the Stops																					✓		✓			
Information access																			✓			✓				
Understandable information			✓																✓	✓		✓				
Faultless & complete information																			✓							
Unambiguous information																			✓			✓				

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Available Information																				✓						
User guidance											✓								✓			✓				
Lack of strain and stress in planning the trip											✓															
Orientation and memory load										✓	✓															
Ease of identifying vehicle														✓						✓	✓					
How easy to recognise Bus Stop					✓																✓					
Getting First Bus									✓																	
Confidence with respect to what to do																			✓							
Confidence with respect to where to go																			✓							
Pre-trip information														✓												
Maps			✓											✓							✓					
Timetables			✓											✓							✓	✓				
Customised local information														✓												
Telephone information services														✓							✓					
Provision of information on the bus														✓												
Multi-lingual presentation of information																					✓					

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Lack of strain and stress (ease) of getting information								✓			✓															
Fixed information display														✓												
Real-time information								✓						✓							✓					
Display of customer service/complaint number								✓													✓					
Staff Attitude					✓			✓	✓		✓		✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	
Disability-informed Staff & Familiarity with personal needs								✓											✓	✓						
Empathetic & Helpful Staff					✓		✓	✓	✓					✓			✓				✓	✓				
Availability of assistance/help	✓							✓			✓								✓		✓					
Ability to handle medical emergencies								✓																		
Ease of complaining								✓											✓							
Follow-up to complaints								✓											✓							
Dignity																			✓							
Being taken seriously as a traveller																			✓							
Suitable driver																			✓							
Motivated driver																			✓							

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Courtesy					✓			✓							✓				✓		✓					
Friendliness								✓											✓		✓					
Driver cooperation in accepting transfers					✓																					
Personal appearance					✓			✓					✓	✓								✓				
Traffic safety					✓			✓													✓	✓				
Willingness to wait					✓																					
Ability to run on time					✓																					
Ability to handle bus smoothly					✓			✓																		
Driver identification														✓												
Safety		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓		✓	✓		✓	✓	✓		✓
Personal Safety															✓							✓			✓	
Safety of locations					✓																✓	✓				
Safety day time																			✓							
Safety night time							✓												✓							
Waiting Safety																						✓	✓			
Safe From Harm		✓					✓	✓																		

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Safety on Board				✓	✓			✓					✓								✓	✓	✓			
Travel safety					✓																✓	✓				
Security Capacity/Protection from crime and bother	✓			✓		✓	✓	✓	✓		✓	✓			✓						✓			✓		
Protected from smoking							✓																			
Easy to travel with children							✓																			
Variety in travel company (i.e. other travellers)	✓																									
Time	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓					✓			✓	✓	✓		
Travel Time	✓	✓	✓	✓		✓	✓							✓					✓				✓	✓		
Wait Time (including transfers)		✓		✓	✓	✓	✓			✓			✓								✓			✓		
Arriving On Time		✓				✓	✓	✓							✓							✓				
Reasonable in-vehicle time													✓						✓							
Waiting time away from home	✓		✓																✓							
Waiting time in the telephone switchboard	✓																		✓							
Waiting times (including Traffic jams)						✓					✓															
Total trip time															✓				✓							
Delays on vehicle								✓											✓							
Pre-booking time																			✓							

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Journey Speed							✓		✓						✓											
Travel Speed of the bus					✓																					
Duration of travel											✓	✓														
Time for access											✓															
Time for changes											✓															
Walking Time	✓		✓	✓									✓													
Fare		✓			✓				✓		✓		✓			✓	✓	✓	✓	✓		✓	✓	✓		✓
Travel Cost													✓					✓								
Cost			✓			✓						✓			✓		✓							✓		
Using Discounted Tickets									✓												✓					
Worth its price compared to public transport																			✓		✓					
Service Cost						✓														✓						
Price					✓																					
Affordability	✓			✓												✓					✓	✓				✓
Private costs											✓															
Comfort		✓			✓	✓		✓	✓		✓	✓	✓	✓			✓	✓	✓			✓		✓		

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Comfort of seats				✓																	✓					
Colour of bus, Appearance, Stylishness	✓				✓			✓																		
Crowding	✓			✓		✓					✓		✓	✓					✓		✓					
Smoothness of ride				✓	✓			✓						✓					✓		✓					
Quietness of bus ride				✓	✓																✓					
Noise made by the bus					✓								✓								✓					
Psychological Distress/Anger						✓	✓				✓															
Enjoying the travel/Fun						✓	✓				✓															
Convenience		✓				✓		✓	✓		✓	✓		✓			✓		✓			✓	✓			
Convenience (seat entering and leaving)											✓											✓				
Availability/Getting Seat	✓			✓	✓				✓	✓			✓		✓				✓		✓					
Types of seats													✓	✓												
Spaciousness of seats													✓	✓												
Seating configuration	✓													✓												
Few restrictions																			✓							
Possibility to choose departure time	✓		✓			✓	✓	✓											✓			✓				

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Destination Choice		✓		✓				✓	✓													✓				
Combination of destinations											✓											✓				
How directly the bus goes to destinations	✓		✓	✓	✓																					
Types of areas the routes go through	✓		✓		✓																	✓				
How close the bus comes to your destinations					✓					✓											✓					
Convenient locations of transfer points					✓																	✓				
Ease of obtaining transfers					✓																✓					
Cost of making transfers																					✓					
Number of transfer points outside downtown																					✓					
Minimal transfers			✓	✓																						
Lack of strain and stress on the way						✓	✓				✓															
Spatial availability of starting points (distance, stairs)											✓															
Spatial availability of destinations											✓															
Spatial availability of connections (point to point travel/necessity to change)											✓															
Service															✓				✓						✓	

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Bus-stop Facilities/Infrastructure					✓			✓						✓							✓	✓	✓			
Type of shelter														✓												
Type of seat														✓												
Lighting	✓													✓												
State of repair														✓												
Condition of the bus & bus stop				✓																	✓				✓	
Bus Stops - weather protection	✓		✓	✓	✓	✓	✓	✓			✓															
Compulsory or request stop														✓												
Stopping position of bus														✓												
Automatic Control		✓												✓												
Sense of personal control											✓															
Freedom of choice	✓						✓	✓			✓											✓				
Feeling independent											✓															
Privacy	✓	✓		✓							✓								✓							
Availability of cash change														✓												
Temperature inside Bus					✓										✓											

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Temperature Control/Air-conditioning/Ventilation	✓	✓		✓			✓	✓						✓							✓		✓			
Avoiding exposure to traffic congestion				✓																						
Making a trip without vehicles	✓																									
Refreshments	✓	✓																								
Booking	✓							✓											✓							
Pre-booking of return								✓											✓							
Availability	✓			✓			✓	✓			✓				✓			✓	✓			✓				✓
Availability at every time				✓			✓	✓			✓															
Availability of Night Services								✓							✓			✓								
Availability of Weekend Services								✓										✓	✓							
Service on weekdays															✓				✓		✓					
Low rate of turning down reservations because of limited capacity								✓																		
Reliability	✓		✓	✓		✓		✓	✓		✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓		
Service reliability	✓							✓						✓					✓		✓					
Punctuality departure								✓											✓							

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Punctuality arrival	✓		✓					✓					✓						✓							
Punctuality pick up time								✓					✓						✓							
Frequency					✓				✓						✓			✓			✓	✓	✓			
Weekday rush hour					✓																					
Weekday non-rush					✓																					
Weekday nights					✓																					
Weekend days					✓																✓					
Weekend nights					✓																✓					
Space	✓	✓				✓	✓	✓			✓								✓							
Room For Strollers/Pushchairs/Wheelchairs	✓	✓						✓																		
Wheel Chair restraint								✓																		
Design of luggage storage area														✓												
Luggage transportation							✓				✓															
Physical Accessibility						✓		✓		✓	✓			✓		✓			✓	✓	✓	✓	✓			✓
Access to the bus							✓	✓			✓											✓	✓			
Walking Distance to/from vehicle/bus-stop			✓	✓			✓	✓		✓													✓			

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Design of vehicle entry steps								✓						✓												
Number of steps								✓											✓							
Vehicle inside design																			✓							
Accessibility of starting points (distance, stairs)											✓															
Accessibility of destinations						✓✓		✓			✓															
Mobility at destination											✓															
Accessibility of connections											✓															
Ease of entry	✓				✓		✓													✓	✓					
Ease of exit	✓				✓		✓													✓	✓					
Ease of reaching bus stop					✓		✓																			
Ease of reaching Vehicle							✓	✓												✓						
Ease of movement inside vehicle					✓		✓							✓							✓					
Number and location of doors														✓												
Availability of Lift unto and off vehicle								✓											✓	✓						
Ease of Use of Lift unto and off vehicle																				✓						
Bus Stops How well located					✓																					

	Golob et al (1972)	Costantino et al (1974)	Spear (1976)	Golob & Recker (1977)	Vanier & Wotruba (1977)	Gensch & Torres (1980)	Koppelman & Pas (1980)	Pagano & McKnight (1983)	Pullen (1992),	Seneviratne &Martel(1994)	Schlag et al (1996)	Hodgson et al (1997)	Ortuzar et al (1997)	Swanson & Ampt (1997)	Forte & Stuart (1998)	Help the Aged (1998b)	Currie (1999)	DETR (1999b)	Knutsson (1999)	Oregon DoT (1999)	TRB (1999a)	TRB (1999c)	Prioni & Hensher (2000)	Sussman (2000)	TRB (2000)	DETR (2001)
Distance to vehicle			✓																✓		✓					
Ease of getting from bus to transfer locations					✓																					
Alternative use of time while travelling	✓			✓									✓													
Value of time																								✓		
Status																								✓		
Ease of paying fares, purchasing tokens	✓		✓																		✓					
Fairness/consistency of fare structure																					✓					
Frequency of delays for breakdowns/emergencies								✓													✓					
Minimum pollution per person				✓								✓														

Based on the literature, and a consideration of the number of times an attribute is cited as presented in Table 4.1 and trying to incorporate as many different types of attributes as possible, a list of travel attributes (shown in Table 4.2) has been derived and will be used in this study.

As can also be seen in Table 4.1, in most surveys, people, whether elderly or not, disabled or not, male or female, indicate strong preferences or desires for safe, convenient, reliable and comfortable transport. These attributes are qualitative, being described by some authors as psychological, ambiguous or abstract in nature (e.g. Levin et al, 1977, Spear, 1976 and Nicolaidis, 1975). These attributes by their very nature are also subjective and difficult to measure.

Neveu et al (1979, p.59) states that for most people, such terms as comfort, convenience and reliability are '*ambiguous*' and they recommend that each of such qualitative term or concept should be represented by a small set of '*non-ambiguous attributes, each of which describes some facet of the concept.*' Thus based also on the literature, more easily measured attributes representing these core attributes above have been listed as shown in Table 4.2 below.

Table 4.2 List of Travel Attributes

Comfort	Protection From Weather
	Clean Vehicle
	Possibility Of Adjusting The Temperature
	No Fatigue Felt From Constant Attention Or Uncertainty
	Sense Of Privacy
	Comfortable Seats
	Smooth Ride
	Leg Room
	Low Noise Level
	Crowding
	Seat Availability
Convenience	Available When Needed
	Minimal Transfers (Vehicles)
	Wheel-Chair Space
	Ease Of Entrance And Exit From Vehicle.
	Storage Space For Luggage, Shopping Bags
	Ease Of Payment (Method)
	Ease Of Booking Service
	Minimal Distance Between Origin/ Destination And Vehicle
	Minimal Constraints On Possible Users
	Possible Destinations (Route)
	Minimal Advance Booking Time
Cost	Price Of Service

Crew Behaviour	Driver Attitude
	Escort Attitude
	Booking Staff Attitude
Information	Routes
	Service Frequency
	Vehicle Arrival Time
Reliability	Waiting Time For Pick-Up
	Travel Time
Safety	Safety In The Vehicle
	Security Between Vehicle And Origin/Destination
Time	In-Vehicle Time

In studies involving a large number of attributes, techniques such as confirmatory factor analysis are usually used to reduce the number of attributes for reasons of experimental and analytical manageability. Sometimes, this restricted list is further minimized by using, in place of the attributes, dimensions that represent groups of attributes. For example, Costantino et al (1974), using factor analysis, considered twelve attributes (wait time, travel time, fare, comfort, automatic control, amount of privacy, arriving on time, safe from harm, room for strollers, able to get to places, refreshments and temperature control) and grouped them under five factors namely:

1. Level of service (wait time),
2. Comfort and privacy (comfort and quietness of ride/amount of privacy),
3. Degree of automatic control (automatic control feature of vehicle),
4. Out-of-pocket cost (fare) and
5. Options and amenities (temperature control in vehicle).

Looking at their final groupings above, it is observed that some attributes have been dropped. The possibility that there would be several users for whom these dropped attributes are very important cannot be ruled out. Thus for such users, the derived model would not adequately represent them or their responses. Spear (1976) has also noted that grouping several attributes under one attribute dimension is problematic as for any one such grouping (e.g. convenience), there are as many definitions of its constituent members as there are individuals in the population.

In this thesis an attempt is being made to develop an individual-user based model. It is therefore considered that the greater the number of possible transport service attributes available for which the users could declare their preferences, the better would be the tailoring of the model to an individual. Thus in this study, no attempt will be made to reduce the number of attributes to be considered as variables in the model. Rather, all possible attributes would be made available for users to express their preferences. Thus, although all possible attributes should be provided for, only those that an individual user considers pertinent or important would be used in computing their satisfaction value for the different transport options. Therefore, any reduction of variables would be dictated by the user's preferences. The fact that different users would have different attribute subsets would not create an apple-pear comparison problem as at any one time the model would compute satisfaction values for different options for only one user. Thus the comparison of different transport options would utilise the same attribute sub-set – that which is unique to the individual involved.

For objective assessment and comparison, there is a need to define the physical and environmental phenomena (i.e. objectively measurable characteristics) that basically underlie these attributes (in Table 4.2). Attempts to define the physical phenomenon gave rise to the list in Table 4.3, which shows descriptions of the levels of service defined for each of the psychological and conventional travel attributes. This list was compiled based on examples from some of the literature reviewed and from the author's experience and knowledge of the possible variations in levels of service for the attributes for different travel modes.

Table 4.3 Attributes Measurable Phenomena and Level of Service

Attributes		Levels of service
COMFORT	Protection from weather	No Bus-stop Shelter
		Bus-Stop Shelter with no sides and no seats
		Bus-Stop Shelter with sides but no seats
		Bus-Stop Shelter with seats but no sides
		Bus-Stop Shelter with sides and seats
		Pick-up at door or near kerb
	Clean vehicle	Dirty Floor & Seats and Dusty Windows
		Dirty Floor and Dusty Windows only
		Dusty Windows and Vehicle Exterior only
		Dusty Exterior only
		Everything Clean
	Possibility of adjusting the temperature	Air-conditioning (Heating &Cooling) Available
		No AC, but Sufficient & Well-located Windows
		No AC and Windows not Well-located
		No AC and Insufficient Windows
	No fatigue felt from constant	Route No/Name & Destination clearly identified

	Attributes	Levels of service
	attention, uncertainty etc	Stops & Stations announced/written on arrival
		Direct journey from origin to destination
		Route No/Name & Destination not clearly identified
		Stops & Stations not announced/written on arrival
	Sense of privacy	All seats facing one direction
		Seats facing each other
		Travelling alone or with chosen company
		Travelling with strangers
	Comfortable Seats	Soft
		Hard
		Narrow
		Anthropometrically-shaped
		Not Anthropometrically-shaped
	Smooth Ride	No sudden braking or take-off
		Infrequent sudden braking or take-off
		Frequent sudden braking or take-off
		Always braking or take-off suddenly
	Leg Room	Not enough space
		Some space
		Enough Space
	Low Noise Level	Always low
		Sometimes low
		Never low
	Crowding	Full Vehicle capacity
		75% Full
		50% Full
		25% Full
		Alone
	Seat availability	Always sure of getting a seat
		Usually sure of getting a seat
		Sometimes sure of getting a seat
		Never sure of getting a seat
CONVENIENCE	Available when needed	Always there
		Often there
		Sometimes there
		Infrequently there
		Never there
	Minimal transfers (vehicles)	No transfer
		1 transfer
		2 transfers
		3 transfers
		4 transfers
	Ease of entrance and exit from vehicle. (Accessibility)	Vehicle has Steps
		Vehicle has Low floor entrance/exit
		Vehicle has a ramp
		Vehicle has a Lift
		Vehicle has Narrow Doors
		Vehicle has Wide Doors
		Vehicle has Handrails
		Vehicle has no Handrails
	Wheel-chair space	None
		Insufficient
		Sufficient
	Storage space for pushchairs, luggage, shopping bags etc	None
		Insufficient
		Sufficient

	Attributes	Levels of service
	Ease of payment (method)	Pay Cash
		Buy Ticket
		Use Pass
	Ease of booking service	Always Difficult
		Often Difficult
		Often Easy
		Always Easy
	Minimal distance between origin/destination and vehicle	Nil Distance
		50m Walk
		100m Walk
		200m Walk
		400m Walk
	Minimal constraints on possible users	No Constraints
		Cost Constraints
		Membership Constraints
	Possible destinations (route)	Goes anywhere
		Some limitations e.g.. borough boundaries
		Fixed route limitations
	Minimal advance booking time	Nil Advance Booking Time
		1hr Advance Booking Time
		6hr Advance Booking Time
		1day Advance Booking Time
		7days Advance Booking Time
COST	**Price of service**	£ 1 per single trip
		£ 2.50 per single trip
		£ 5 per single trip
		£ 10 per single trip
		£ 30 per single trip
CREW BEHAVIOUR	**Driver Attitude**	Very Helpful
		Not Helpful
		Slightly Helpful
	Escort Attitude	Very Helpful
		Not Helpful
		Slightly Helpful
	Booking Staff Attitude	Very Helpful
		Not Helpful
		Slightly Helpful
INFORMATION	**Routes**	Information Available before journey
		Information Available during journey
		Information Not Available before journey
	Service Frequency	Information Available before journey
		Information Not Available before journey
	Vehicle arrival time	Information Available before journey
		Information Not Available before journey
RELIABILITY	**Waiting Time for pick-up**	On-Time Arrival
		5 min late
		15 min late
		30 min late
		1 hour late
	Travel Time	Always consistent
		10 min variation
		30 min variation
		1 hour variation
SAFETY	**Safety in the vehicle**	High risk of accident & attack from other users
		Moderate risk of accident & attack from other users
		Low risk of accident & attack from other users

Attributes		Levels of service
		Nil risk of accident & attack from other users
	Security between vehicle and origin or destination	High risk of accident & attack
		Moderate risk of accident & attack
		Low risk of accident & attack
		Nil risk of accident & attack
TIME	**In-vehicle time**	Long
		Moderate
		Short

4.5 CONCLUSION

This chapter has presented the issues pertinent to the development of the proposed Transport-User Satisfaction Model (TUSM). It has reviewed issues pertinent to modelling generally and to transport satisfaction specifically. It has also reviewed alternative techniques of model development and selected techniques suitable for the two-stage modelling proposed in Chapter 3. Literature on attributes of travel has also been reviewed and a comprehensive list of attributes drawn up to be used in the design of suitable survey instruments.

In the next chapter, the design and conduct of a survey for this study and the data-collection and data analyses processes will be presented.

CHAPTER 5

DATA COLLECTION AND ANALYSIS

5.1 INTRODUCTION

The previous chapter presented the issues relevant to the development of the proposed Transport-User Satisfaction Model (TUSM). It reviewed issues pertinent to modelling generally and to transport satisfaction specifically. It also reviewed alternative techniques of model development and selected techniques suitable for the two-stage modelling proposed in Chapter 3. Literature on attributes of travel was also reviewed and a comprehensive list of attributes drawn up to be used in the design of suitable survey instruments.

This chapter will present the design and conduct of a survey for this study and the data-collection and data analyses processes. This study involves obtaining data on the variables with which the Transport-User Satisfaction Model could be developed. It also involves the development of a framework for the use of this model in a transport brokerage setting. Section 5.2 presents issues relevant to the survey methodology. Section 5.3 presents the data collection process, while Section 5.4 summarises the data collected and Section 5.5 presents the data analysis procedures. Section 5.6 presents a framework for the decision support tool and the chapter is concluded in Section 5.7.

5.2 SURVEY METHODOLOGY

5.2.1 Introduction

Several methods have been developed for measuring passengers' attitudes, feelings and perceptions in relation to public transport services. They include opinion research questions, scaled questions and interactive techniques (Pullen, 1992). Most studies have used the scaled questions approach, as this results in more systematic and easily understood output. Interviews have also been used to elicit more qualitative responses (Richardson et al, 1995). In this study, both interview and scaled questions methods will be used. This is because while there is a need to obtain quantitative data for the model development, the very nature of the models requires an understanding of the qualitative nature of the responses.

In scaled questions surveys, respondents could be asked to use either ranking or rating techniques to indicate their preferences and/or opinions. While ranking can produce outright preferences (although at the expense of knowledge of the degree of preference), it has the disadvantage that as the number of alternatives increase, it becomes very difficult for respondents to make meaningful comparisons. The rating technique does not have this disadvantage and by providing information on the degree of preference or strength of opinion, it is quite useful in obtaining a quantitative value for respondent's perception of the measured concept. Such quantifications are useful in analysis.

In data collection, stated preference designs are very commonly used in transport studies (Richardson et al, 1995) especially when there is a requirement to determine the preferences of people in relation to attributes that do not exist at the time of the survey. However, they are not particularly suitable for analysing transport service satisfaction. This is because the satisfaction judgement is an expression of a reaction to the actual experience of a service or product, and imagination cannot replace that direct experience. De Rutyer et al, (1997) used this characteristic of satisfaction judgement to distinguish satisfaction from service quality judgement, which can be made without actually experiencing the service. For this reason, a stated preference approach will not be used in this study. Rather a revealed preference-like approach will be used whereby people would be asked to rate services they have actually experienced.

5.2.2 Target Population

The target population for this study consists of the group of people referred to as transport disadvantaged in Chapter 2. Initially, it was planned to reach this population through the registered membership of large community transport (CT) organisations in London. The community transport organisations were to be selected to represent as diverse a user population as possible. However, getting these organizations to participate in this study was difficult as most of them declined participating. The reasons given for their declining ranged from "Not convenient" to an expressed fear that the survey would create a service-quality awareness in their clients that they may not be able to satisfy. Four CT organizations (representing North, South, East and West London) eventually agreed to participate. However, at the last minute, one of the CT groups pulled out of the survey. So it was decided to change this plan especially as the possibility of certain sub-sets of the transport-disadvantaged group like the unemployed not being represented among these CT clients was found to be high.

It was then decided to conduct a stratified random selection of members of the transport-disadvantaged group. Thus, the first thing done was to identify the different strata or clusters in which members of the target population are found and identify potential day-time locations where they could be met. Horowitz and Sheth (1977) have reported an advantage over traditional data collection methods of contacting respondents at their regular day-activity venue e.g. contacting commuters through their employers. They noted a higher return rate (50%) as compared to mailed-out surveys.

The characteristic used to stratify the population was based on a life-stage indicator represented by a mix of occupation and age. This characteristic was felt to have more impact on transport preferences than other possible alternative respondent socio-characteristics because it seems sensible to assume that people's occupation and age would tend to influence most, what they do, where they go and when. Thus there were six groups of people from whom samples were to be collected: Students, Elderly, Unemployed, Low-income Workers, Parents Of Young Children and

Disabled People. The contact places identified for these groups of people were as follows: Schools (primary, secondary and tertiary levels); Job-centres; Nurseries and child-care centres; Day Centres for the elderly; and Sheltered Housing homes (for the elderly and infirm). In recognition of the possibly low representation of disabled persons within the main places of contact for these groups, disabled persons were contacted through their disability-group advocacy centres.

The survey was to be conducted in London, but all of London could not be covered, so using the 2000 Deprivation Indices for the country (DETR, 2000c), five most deprived boroughs in London were selected. These boroughs were: Hackney, Newham, Islington, Camden and Greenwich. To input the possible effect of more affluent boroughs, the City of Westminster was also selected. Thus, the survey was conducted in these boroughs. In each borough, contact locations for the identified strata for the target population were visited and the management informed of the purpose of the survey and asked for permission to administer the questionnaires to their clients/members. For the organizations that gave consent, questionnaires were provided for the entire population they served, i.e. within the organization, no selection/sampling was done and all potential respondents at that location had the opportunity to fill a questionnaire if they wanted.

The immediate concern of the non-respondent bias expected was considered to be a potential advantage. This is because it was felt that people who are willing to respond to a survey have a view on the issue in question and in this study where it is desired to understand the judgement process of transport users, the results are enriched by the inputs of such people more than the inputs of the unwilling. Richardson et al (1995, p.100) have reported that non-response for mail-back questionnaires is generally an indication of a low level of interest in the subject of the survey by the non-respondent.

While most studies on transport satisfaction have been interested in determining which attributes have the greatest potential to affect user satisfaction and thus used regression analysis/principal component analysis, this study is interested in deriving a function that can predict satisfaction given a knowledge of the attributes important to the user and the performance level on each attribute by a transport option. Thus there is a need to be able to identify clearly, the judgement process that links the level of transport service experienced with the user's satisfaction with it. Therefore, in identifying that judgement process, returns from willing respondents would be more useful than those from unwilling respondents.

It must be noted here that as this study was not intended to make generalizations of outcome to the population, but rather, as a pilot study, to investigate the possibility of modelling adequately an individual's satisfaction judgement process, a large-scale survey was not necessary. Instead, the study made use of as many people from each of the relevant groups of transport-disadvantaged people as could be obtained.

5.2.3 Questionnaire Design

The questionnaire to be used for the survey of a sample of the defined target population was designed to yield information on the socio-economic characteristics of age, gender, employment status and disability characteristics (if any) of the respondents as well as their most frequently used means of transport and their level of experience of demand-responsive transport. It was also to yield information (importance rating and satisfaction rating) on the travel attributes considered important by the respondent for his or her satisfactory experience of the transport service they use most often. The variation of attribute importance ratings by trip purpose was also to be collected. The respondent's overall satisfaction rating for the transport service was also to be recorded.

Current attribute importance measurement is based upon the work of Fishbein and Ajzen (1975). They have suggested that attribute importance can be measured by asking the respondent to rate the relative importance of each attribute. This approach is in keeping with that used by a number of other researchers (Engel, and Blackwell 1982; Cunningham 1967; Bolfing 1985). Similarly, researchers have traditionally asked respondents to state their level of satisfaction/dissatisfaction along a 5 or 7 point Likert-type scale. Oliver (1981) notes that attempts to measure overall satisfaction using a scale ranging from "extremely satisfied" to "not satisfied" cannot accurately gauge satisfaction levels because it does not provide for degrees of satisfaction. Oliver (1980a, 1980b) asserts that asking a consumer to evaluate satisfaction on a typical satisfaction/dissatisfaction scale presents a construct validity problem because it is really asking the respondent to restate his or her perceived confirmation/disconfirmation.

To the extent that satisfaction/dissatisfaction is something different from confirmation/disconfirmation, the traditional approach might fail to detect this difference. Given these criticisms, it is desirable that the satisfaction/dissatisfaction measure is deemed to be the result of the confirmation/disconfirmation of the normative standards or norms and not simply a restatement of the confirmation/disconfirmation evaluation. Such an approach captures the emotional response to the disconfirmation of normative standards (Oliver 1980a). Thus an appropriate scale range should indicate degrees of satisfaction i.e. "how satisfied".

Therefore in the questionnaire for this study, respondents were asked to rate their degree of satisfaction with the transport service on a scale of 1 – 10 and their attribute importance rating on a scale of 1 – 5. The decision to use different scale sizes was to reduce the chances of respondents comparing and matching their ratings for attribute importance and satisfaction. The final questionnaire used in the survey is shown in Appendix 1.

5.3 DATA COLLECTION

5.3.1 Introduction

A twin approach to data collection was taken, using qualitative and quantitative methods such as interviews and a questionnaire survey. Interviews were held with the management and staff of community transport organizations including a transport brokerage to determine the issues relevant to vehicle selection processes. Interviews were also held with selected members of transport-disadvantaged groups to ascertain the validity of the travel attributes list generated for this study. A questionnaire survey of the target population as described in Sec. 5.2.2 was then conducted. The data collection processes (i.e. interviews, meetings and questionnaire survey) for this study was conducted during the period October 2001 – June 2002.

5.3.2 Interviews

A series of interviews and meetings were held with managers of two community transport services in London representing the traditional community transport scheme and one with a transport coordination centre. The traditional CT scheme is one of the oldest operational schemes in London, while the other CT scheme is relatively new and had recently undergone innovative and radical changes in operation style culminating in a brokerage-style coordination centre. Interviews were also conducted with the supervisor and other staff of the booking section of the community transport service that operated a brokerage scheme to determine the specific requirements of the brokerage booking system. The interviews took a semi-structured form with some guide-questions, the answers to which were allowed to flow out of open discussion. The list of the guide-questions is shown in the appendix (A.2). Comments by the managers included the following:

> *" the types of requests we get are often for school trips and trips related to people registered with the social services. The agencies that mainly commission us are the Social Services and the Education Department who also set the criteria for who is eligible for special needs transport based on their own specifications. The users usually consist of children with behavioural problems or children in care/foster homes." – Manager A.*

> *"We cater for group services when members* [organisations] *of the community come to us and ask for a vehicle to make a trip. We provide them with the vehicle and a volunteer driver. We also have a Community Car Scheme that provides services for individuals who can't use public transport". – Manager B.*

> *"The calls are mostly regular and booked about 2 days ahead. We often get ad hoc requests but rarely, about 2 - 3 a day. The requests are often made by phone calls and by faxed massage". – Manager A.*

> *"Our requests are booked a week ahead to enable arrangements for the volunteer drivers ". – Manager B.*

"Dial-A-Ride and the occasional school want transport for a trip for the children. The basic criterion is ability to pay" – Manager A.

"We charge for vehicle hire. For the Community Car Scheme, it is a flat rate within our borough, but includes a further rate/distance from client's home address for trips outside our borough. For the minibus hire, the charges include mileage charge and session charge " – Manager B.

"For now, we use minicabs and minivans. We contract them to provide transport for our clients. We also get to purchase transport for those trips that Dial-A-Ride can not take up. Dial-A-Ride reciprocates by giving us their vehicles (2) to use in their off-time (or down time), which happens to be our peak time i.e. 8-9.30am and 3-4.30pm". – Manager A.

"We have our own fleet of vehicles – mainly minibuses. Though for the Community Car Scheme, volunteers' cars are also used. " – Manager B.

"User-needs specifications vary widely, but we do try to meet them. We try to match the vehicle/service provided to the specified user needs. This would include police checked crew and escorts if necessary " – Manager A.

"We rely on volunteer drivers to run. Vehicles are provided based on availability, though if the group can provide their own driver (who would have been checked out by us), we could still provide them with a vehicle." – Manager B.

"User satisfaction is monitored primarily through the surveys we conduct intermittently. We also receive and consider feedback phone calls from the users, their carers, and the drivers. We try not to send out surveys too often so as not get 'questionnaire fatigue'." – Manager A.

"We regularly send out questionnaires to our clients to monitor their views on the quality of service we are providing." – Manager B.

"I am concerned about some questions in your proposed questionnaire. Asking our clients about their preferences could raise their expectations and we don't want to raise their expectations and not be able to meet them." – Manager A.

"The major constraints for now are our limitations in terms of communication technology. Also properly trained staff and appropriate scheduling software are scarce. For now, dispatching requires poring over The A-Z and London post-code [these are comprehensive street-maps of London]*." – Manager A.*

Comments from the transport booking staff included the following:

> *"Time constraints affect booking coordination. Need longer advance booking time to enable better scheduling and combination of similar trips i.e. similar Origin or Destination."*
>
> *"Being in the voluntary sector, finances are slim."*
>
> *"We lack adequate technology".*
>
> *"We don't have software for despatching, routing, computing travel distances, booking, or matching client requests and specific needs to suitable transport provider".*
>
> *"Most of the activities involved in providing our service, we have to do manually, sifting through lots of paperwork, which brings back the time constraint problem."*
>
> *"We match needs and vehicle on the basis of 'best value and appropriate mode'. Best value i.e. cost-wise for the sponsors, and appropriate to the client's needs. "*

These consultations confirmed the limitations of booking systems as presented in Chapter 2. They also revealed the need for computerisation of booking systems for greater efficiency in terms of the time spent, going through records, determining whether or not a travel request can be booked or not. Also revealed was a slight inclination by some operators to want to maintain the status quo. They feared that a study of users' preferences might raise the users' expectations to levels of service quality that they may not be able to meet. This suggested that a preference-based vehicle allocation could improve the quality of transport services provided since transport managers seem to feel that if their customers had more say in the service they got, the service provided could be different from what is presently offered. These interviews and meetings also yielded the database information requirements of community transport brokerage operations and the current vehicle selection process. This information is relevant to the design of the decision support system framework, which will be presented in Section 5.6.

Group meetings were also held with elderly and some disabled users of one of the previously contacted community transport services. The purpose of the meetings was to elicit, the travel attributes of importance to them and their estimation of the order of preference or ranking of the attributes. From the meetings, the attributes of most importance to them turned out to be attributes pertaining to safety and accessibility like having a helpful escort, a clean vehicle, a considerate driver and ease of entering the vehicle. Issues like reliability and in-vehicle travel time, though important to some of them, were not considered as important as any of the first four even to those who considered them important. The second set of group meetings to estimate a ranking of the attributes showed that they considered a good escort and clean vehicle more important than reliability and in-vehicle time. They were, however, unable or unwilling to differentiate between 'good escort' and 'clean vehicle', stating: *"a good escort would ensure we have a clean vehicle"*. This implies some association between "Escort" and "Clean vehicle" and could affect their simultaneous use in a model, at least for this group of users.

A meeting with parents of young children of nursery age, yielded the following information: Their major concerns were for considerate transport staff, space for buggies and shopping, and smooth stopping and starting of the transport vehicle. A group meeting was also held with disabled people. For this group, the major concerns were for safety in transit, ease of access/exit, smooth vehicle stopping and starting, and cooperative transport crew. Some were quite concerned about seat availability. A few were concerned about having adequate space – legroom.

The other proposed sets of group meetings with younger transport users could not be held because of restrictions on direct access to children, some of who were in social care and permission to interview them could not be obtained. It thus became necessary to proceed to the questionnaire development stage without the benefit of a group meeting with younger users. However, an alternative approach was taken to contact this younger group. An anonymous questionnaire survey was administered in an inner London primary school with a high multi-cultural mix of pupils. The questionnaire listed all the identified travel attributes and asked the children to tick all those they considered important to having satisfactory journeys to school, and to recreational activities. The survey was administered to two-year groups (aged 9 years and 11 years) by two of the teachers. The purpose of survey was explained to the teachers and any terminology they were not clear with or they felt would not be clear to the children was also explained to them.

The analysis of this survey indicated that for young children, the following attributes were very important: 'Being dropped off on time' and 'Being picked up on time'. Other important attributes included Safety in the vehicle, Comfortable seats and Clean vehicle. They also considered the length of time spent waiting and travelling important. Considerate staff was not as important and neither were Noise level, Method of payment, Security between vehicle and origin/destination. Given their concern for safety, perhaps this less concern for out-of-vehicle security could be because adults or older siblings accompany the majority of these children on their trips.

The outcomes of these meetings/survey suggest that there is variation in attribute preferences amongst different groups of people. Thus the compiled list of travel attributes as shown in Section 4.4.2 was maintained and used in the questionnaire.

5.3.3 Questionnaire Administration

After the interviews, the survey questionnaire was designed and a pilot survey was conducted to identify problematic questions and sections. A major problem identified was that the pilot respondents found the cognitive exercise of rating the travel attributes for importance and satisfaction, and for different trip purposes, very demanding and considered the questionnaire to be too long. So it was decided to reduce the length of the questionnaire by taking out the section replications for different trip purposes and thus the variable 'trip purpose' was eliminated.

Though the conventional transport modeller would consider trip purpose a very important attribute, in this study the effect of trip purpose is essentially to show the variation (if any) in attribute importance for different trip purposes. It is the effect of travel attribute importance on transport satisfaction that is being studied here and not the effect of trip purpose. Thus, the *important* variable here is the variation in attribute importance with respect to transport satisfaction. Thus, it is not essential to have trip purpose as a variable in this study.

To further reduce the length of the questionnaire (to three A4 pages) and so encourage completion of the questionnaire, information on individual-specific attribute level of service was separated from the main questionnaire to be completed separately (in a second phase).

A total of 500 questionnaires were distributed to the target population groups at the selected locations where they were expected to be: such as schools, day centres, disabled groups centres, sheltered housing, job centres and nurseries. The breakdown was as follows:

1. Schools: 150
2. Day centres for the elderly: 100
3. Disabled groups centres: 100
4. Sheltered housing: 50
5. Job centres: 50
6. Nurseries: 50

Of the 500 questionnaires distributed, a total of 173 questionnaires were returned, i.e. a return rate of 34.6%, which is considered quite good for a self-completing questionnaire survey. However, the proportion of the respondents who gave their contact details for a follow-on survey was so minute (<6% of the returned questionnaires), it was thought inappropriate to use only their inputs on the attribute levels of service. Thus the expected level of service for an attribute, given the individual's mode of transport was used as input for attribute level of service (LOS). Using the expected level of service rather than the actual level of service could reduce the precision of the model. However, considering that in practical usage, the computation of satisfaction for a user would be before the trip is made implies that the user of the model would be using the expected level of service (based on the past records) for that transport rather than the actual level of service the user would encounter.

5.4 DATA SUMMARY

5.4.1 Socio-Demographic Variables

A summary of the socio-characteristics of the respondents to the questionnaire survey is shown in Table 5.1 below. The collected data consisted of 173 returned questionnaires, of which 1 was invalid and therefore removed. The final dataset used in analysis, however, consisted of 164 questionnaires as eight questionnaires were found to be incomplete and removed also. Removing them does not appear to have altered the data summary much (see Table 5.1).

A phenomenon worth discussing here is the relatively high number of respondents who fall into the Student occupation category. This is not surprising since most young people would be students and many older people who are still studying would consider themselves to be of low-income. This is especially so as unemployed people or people on low-income, in an attempt to be more employable or get better jobs, go back to school for more training. It is also acknowledged that the questionnaires administered through schools would have a higher response rate than those administered through other contact places. This would be due to the students filling the questionnaire in response to instructions from the school authorities.

While the gender ratio in the sample is close to the gender proportioning in the UK population where Male:Female ratio = 49%:51%; the disability ratio in the sample is not so close – Disabled:Nondisabled = 9%:91% in the sample but 14%:86% in the UK population (National Statistics, 2002). This could be indicative of the poor questionnaire returns from the disabled people group. This was quite disappointing as of all the transport disadvantaged people groups, disabled people's needs are considered to be most critical especially as their constraints could be more permanent than the constraints of other groups. Despite repeated reminders at their advocacy centres, response by disabled people to the questionnaire survey was very low. It had been assumed that they would be very interested in the study and its potential output. Perhaps this is more a case of disillusionment rather than of disinterest.

However, the possible effect of the questionnaire on the relatively low response rate cannot be discounted. It does appear that some respondents especially in the disabled and the elderly people categories may have found the questionnaire difficult to complete. On reviewing the questionnaire, three possible reasons for this can be considered. First, the attempt to reduce the number of pages of the questionnaire by placing the columns for the importance rating and the satisfaction rating for the transport attributes on the same page may have made the cognitive exercise appear harder. Secondly, some of the terminology used in the questionnaire introduction page may not have been as obvious to the layperson as was initially believed. Thirdly, the questions on personal details were placed before the main questions relating to the subject matter of the survey, and this might have caused some potential respondents to feel uncomfortable.

More generally, the survey methodology employed (a questionnaire mail-back exercise), although suitable for this research study, is not particularly renowned for achieving high response rates. However, alternative methods – such as a telephone survey, or a survey where the interviewer is present, or a postal survey with reminders – all have disadvantages that made them difficult to use in this study. Critical amongst such disadvantages were the possibility of interviewer bias affecting the data and the increased cost and time requirements of these alternative methods over the method used in this study. Given the objective of this study, it was considered that having a smaller dataset would be a lesser disadvantage than having data with bias due to the influence of interviewers.

Table 5.1 Socio-Demographic Profiles of Respondents

Variable	Proportion in Original Sample (N=172)	Proportion in Reduced Sample (N=164)
Gender	Male = 80 (46.5%) Female = 92 (53.5%)	Male = 75 (45.7%) Female = 89 (54.3%)
Disability	Disabled = 17 (10%) Non-disabled = 155 (90%)	Disabled = 15 (9.2%) Non-disabled = 149 (90.8%)
Age Group	0-19yrs = 100 (58.1%) 20-39yrs =36 (20.9%) 40-59yrs = 13 (7.6%) 60-79yrs = 17 (9.9%) 80+ = 6 (3.5%)	0-19yrs = 96 (58.5%) 20- b39yrs =35 (21.4%) 40-59yrs = 13 (7.9%) 60-79yrs = 16 (9.8%) 80+ = 4 (2.4%)
Occupation	Student = 116 (67.4%) Working = 27 (15.7%) Homemaker =3 (1.7%) Job-seeker =2 (1.2%) Retired = 24 (13.9%)	Student = 111 (67.7%) Working = 27 (16.5%) Homemaker =3 (1.8%) Job-seeker =2 (1.2%) Retired = 21 (12.8%)
Most Regular Transport Mode Used	Bus = 90 (52.3%) Walk = 7 (4.1%) Tube = 36 (20.9) Train = 7 (4.1%) Community T. = 6 (3.5%) Car = 19 (11%) Cycling = 1 (0.6%) Cab = 6 (3.5%)	Bus = 87 (53.0%) Walk = 5 (3.0%) Tube = 36 (22.0%) Train = 7 (4.3%) Community T. = 5 (3.1%) Car = 17 (10.4%) Cycling = 1 (0.6%) Cab = 6 (3.6%)

Within the sampled groups, the number of attributes considered relevant to overall transport satisfaction ranged from 1 – 34. Figure 5.1 below displays the distribution of number of relevant attributes among the respondents. It was observed that a majority of the respondents considered 30 or more attributes to be relevant to their satisfactory experience of transport service. This suggests that just knowing what is important may not be as useful as knowing how important it is (i.e. degree of importance), in developing a system of determining people's preference ranking.

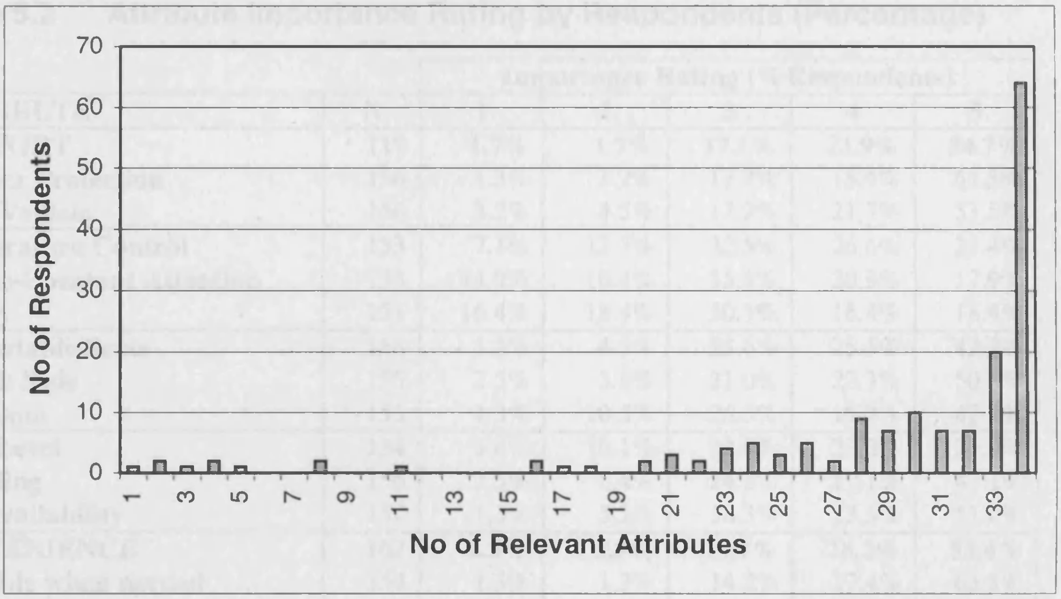


Figure 5.1 Distribution of Number of Relevant Attributes

5.4.2 Attribute Importance Ratings

Overall, respondents rated importance for most of the attributes as 3, 4, or 5 on a scale of 1 – 5. This was especially so for the core attributes. (See Table 5.2 and note that for inclusion in this table, ratings with fractional values were rounded up to the next whole number). A few attributes like Wheel-Chair Space, Storage Space and Advance Booking Time, however, had slightly more even distributions of the ratings; and Privacy and Constant-Attention Fatigue had normal distributions of the importance ratings.

It does appear that if a relatively large number of attributes are presented, people would find those they really consider important and those they don't. Also for those attributes that consistently remain "top-heavy" in importance (i.e. have ratings at the higher end of the scale), they may make up the attributes that are considered critical and essential for satisfaction. For such attributes, although their presence may not affect satisfaction greatly, their absence would cause much dissatisfaction (Johnson and Gustafsson, 2000).

Table 5.2 Attribute Importance Rating by Respondents (Percentage)

ATTRIBUTE	N	Importance Rating (% Respondents) 1	2	3	4	5
COMFORT	**117**	**1.7%**	**1.7%**	**17.1%**	**23.9%**	**54.7%**
Weather Protection	156	1.3%	3.2%	17.9%	15.4%	61.5%
Clean Vehicle	156	3.2%	4.5%	17.2%	21.7%	53.5%
Temperature Control	153	7.1%	12.3%	32.5%	26.6%	21.4%
Fatigue-Constant Attention	134	14.9%	10.4%	35.8%	20.9%	17.9%
Privacy	151	16.4%	18.4%	30.3%	16.4%	18.4%
Comfortable Seats	156	3.2%	4.5%	23.6%	25.5%	42.7%
Smooth Ride	155	2.5%	3.8%	21.0%	22.3%	50.3%
Leg Room	155	1.3%	10.3%	26.3%	19.9%	42.3%
Noise Level	154	5.8%	16.1%	32.9%	23.2%	21.9%
Crowding	156	2.5%	6.4%	24.8%	19.1%	47.1%
Seat Availability	152	1.3%	5.2%	18.3%	23.5%	51.6%
CONVENIENCE	**102**	**2.9%**	**3.9%**	**11.7%**	**28.2%**	**53.4%**
Available when needed	154	1.3%	1.3%	14.2%	17.4%	65.8%
Vehicular transfers	133	7.5%	6.7%	29.1%	22.4%	34.3%
Wheel Chair Space	139	19.4%	8.6%	18.0%	13.7%	40.3%
Ease of Entry/Exit	151	5.3%	7.9%	19.9%	23.8%	43.0%
Storage space	154	4.5%	14.2%	25.2%	27.1%	29.0%
Ease of payment	148	4.1%	6.8%	23.6%	24.3%	41.2%
Ease of booking service	125	5.6%	11.9%	32.5%	19.8%	30.2%
Vehicle-O/D distance	146	6.1%	5.4%	25.2%	27.2%	36.1%
User Constraints	129	3.8%	8.5%	31.5%	23.8%	32.3%
Possible destinations	136	4.4%	2.2%	16.1%	31.4%	46.0%
Advance booking Time	124	14.4%	8.8%	24.8%	23.2%	28.8%
COST	147	3.4%	2.0%	19.6%	21.6%	53.4%
CREW BEHAVIOUR	**113**	**3.5%**	**5.3%**	**18.4%**	**14.9%**	**57.9%**
Driver Attitude	153	6.5%	3.9%	18.2%	18.8%	52.6%
Escort Attitude	118	9.2%	7.6%	18.5%	20.2%	44.5%
Booking Staff Attitude	117	6.8%	5.9%	16.1%	19.5%	51.7%
INFORMATION	**78**	**5.1%**	**2.6%**	**24.4%**	**11.5%**	**56.4%**
Routes Information	140	2.9%	3.6%	13.6%	20.0%	60.0%
Service frequency info	138	2.9%	1.4%	11.6%	23.9%	60.1%
Arrival time Info	144	1.4%	2.8%	15.3%	21.5%	59.0%
RELIABILITY	**92**	**2.2%**	**2.2%**	**15.2%**	**14.1%**	**66.3%**
Waiting Time	136	2.9%	2.9%	17.6%	20.6%	55.9%
Travel Time	141	0.7%	3.5%	16.3%	24.8%	54.6%
SAFETY	**96**	**4.2%**	**3.1%**	**12.5%**	**11.5%**	**68.8%**
Invehicle Safety	142	2.1%	1.4%	12.7%	11.3%	72.5%
Vehicle to O/D Security	139	2.2%	3.6%	20.9%	13.7%	59.7%
TIME	135	3.0%	6.7%	23.0%	21.5%	45.9%
MEAN	136.6	4.99%	6.04%	21.1%	20.8%	47.1%
MAX	156	19.4%	18.4%	35.8%	31.4%	72.5%
MIN	78	0.7%	1.30%	11.6%	11.3%	17.9%

It is worth noting that for the core attributes with 'subsidiary' attributes, more respondents indicated the subsidiary attributes as relevant than they did the core attributes. Within the group of a core attribute and its subsidiary attributes, the number of respondents indicating them as relevant varied. This suggests that grouping the subsidiary attributes, as one core attribute, would have been inimical to the purpose of this thesis. Apparently a core attribute such as CONVENIENCE could mean several different things to different people and each of its subsidiary attributes could also have different importance values for different people. Similarly, TRB (1999a) found that within what they called attribute 'dimensions' (i.e. core attributes), respondents varied as to which 'factor' (i.e. subsidiary attribute) was most important. They also found that given the opportunity, different respondents placed the same factors within different attribute dimensions. Thus they suggest that caution should be observed in reducing individual factors to "umbrella" dimensions.

5.4.3 Satisfaction Ratings

Overall, respondents' satisfaction ratings for the attributes were very varied. See Table 5.3 below. (Note that for inclusion in this table also, ratings with fractional values were rounded up to the next whole number). The presence of fractional satisfaction ratings e.g. 6.5, confirms the assertion in Section 4.3.2 that an end-anchored, non-categorised scale is continuous and interval in nature. The distribution pattern of the ratings approximated normal distributions (most skewness values were not greater than 1 (Cavana et al, 2001, p.413)). This pattern also confirms that people do vary in their satisfaction even for similar services.

Table 5.3 Attribute Satisfaction Rating by Respondents (Percentage)

	Satisfaction Rating (% of Respondents)									
ATTRIBUTE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Overall Satisfaction	1.2%	4.8%	1.8%	4.8%	15.6%	13.2%	22.8%	23.4%	5.4%	7.2%
COMFORT	0.9%	5.1%	7.7%	4.3%	7.7%	13.7%	27.4%	23.1%	4.3%	6.0%
Weather Protection	1.9%	3.2%	0.6%	3.2%	6.5%	9.7%	7.8%	17.5%	13.0%	36.4%
Clean Vehicle	7.8%	9.7%	9.7%	11.7%	18.8%	9.1%	14.9%	7.8%	4.5%	5.8%
Temperature Control	21.3%	10.0%	11.3%	9.3%	12.0%	11.3%	5.3%	8.0%	2.7%	8.7%
Fatigue-Constant Attention	7.0%	7.0%	8.6%	11.7%	18.8%	14.8%	13.3%	14.1%	2.3%	2.3%
Privacy	18.9%	10.8%	10.1%	14.9%	11.5%	6.8%	6.8%	8.8%	1.4%	10.1%
Comfortable Seats	4.5%	7.1%	7.8%	9.7%	6.5%	14.9%	15.6%	18.2%	5.2%	10.4%
Smooth Ride	7.1%	7.1%	5.8%	4.5%	13.5%	15.5%	18.1%	11.6%	4.5%	12.3%

	Satisfaction Rating (% of Respondents)									
ATTRIBUTE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Leg Room	7.2%	6.6%	9.2%	11.8%	11.8%	13.2%	11.2%	14.5%	2.6%	11.8%
Noise Level	11.2%	5.3%	13.2%	7.9%	15.1%	15.1%	9.2%	14.5%	3.3%	5.3%
Crowding	20.0%	11.6%	9.7%	9.7%	9.0%	12.9%	11.0%	9.7%	0.0%	6.5%
Seat Availability	8.7%	11.3%	9.3%	10.0%	12.7%	13.3%	15.3%	10.0%	1.3%	8.0%
CONVENIENCE	2.0%	6.1%	9.1%	4.0%	14.1%	12.1%	19.2%	12.1%	12.1%	9.1%
Available when needed	4.6%	8.5%	6.5%	9.2%	10.5%	17.6%	13.1%	11.1%	7.8%	11.1%
Vehicular transfers	3.2%	9.6%	8.0%	7.2%	12.0%	12.8%	17.6%	17.6%	4.0%	8.0%
Wheel Chair Space	16.7%	9.8%	6.8%	6.1%	15.9%	9.8%	10.6%	8.3%	5.3%	10.6%
Ease of Entry/Exit	4.0%	5.4%	3.4%	6.0%	13.4%	8.1%	14.8%	21.5%	10.7%	12.8%
Storage space	9.9%	6.0%	8.6%	9.9%	15.2%	9.3%	18.5%	11.9%	4.0%	6.6%
Ease of payment	3.4%	4.1%	3.4%	5.5%	6.2%	8.9%	22.6%	15.1%	13.0%	17.8%
Ease of booking service	9.6%	2.6%	4.3%	9.6%	15.7%	10.4%	14.8%	15.7%	5.2%	12.2%
Vehicle-O/D distance	4.3%	2.8%	6.4%	10.6%	12.1%	14.9%	17.7%	17.0%	5.7%	8.5%
User Constraints	3.2%	2.4%	8.8%	11.2%	16.8%	11.2%	19.2%	16.8%	3.2%	7.2%
Possible destinations	3.0%	2.3%	5.3%	6.8%	12.8%	6.0%	18.8%	19.5%	10.5%	15.0%
Advance booking Time	7.0%	6.1%	7.0%	10.4%	14.8%	7.8%	18.3%	13.0%	7.0%	8.7%
COST	10.4%	9.7%	5.6%	7.6%	9.7%	11.8%	13.2%	12.5%	8.3%	11.1%
CREW BEHAVIOUR	7.4%	3.7%	4.6%	9.3%	12.0%	9.3%	19.4%	17.6%	7.4%	9.3%
Driver Attitude	8.0%	6.0%	5.3%	3.3%	11.3%	12.7%	20.0%	14.7%	7.3%	11.3%
Escort Attitude	10.8%	10.8%	4.5%	6.3%	15.3%	5.4%	13.5%	10.8%	9.0%	13.5%
Booking Staff Attitude	10.7%	6.3%	5.4%	6.3%	13.4%	17.0%	8.0%	14.3%	7.1%	11.6%
INFORMATION	3.9%	1.3%	2.6%	7.9%	9.2%	18.4%	19.7%	14.5%	6.6%	15.8%
Routes Information	3.6%	3.6%	2.2%	7.2%	13.0%	9.4%	15.9%	21.0%	8.7%	15.2%
Service frequency info	3.7%	9.6%	7.4%	7.4%	13.2%	14.0%	18.4%	14.7%	4.4%	7.4%
Arrival time Info	5.6%	9.2%	11.3%	6.3%	11.3%	14.1%	12.0%	19.0%	4.2%	7.0%
RELIABILITY	5.7%	3.4%	9.1%	5.7%	13.6%	13.6%	13.6%	17.0%	5.7%	12.5%
Waiting Time	7.5%	8.2%	9.7%	11.9%	6.7%	16.4%	19.4%	9.0%	6.7%	4.5%
Travel Time	3.6%	2.9%	8.7%	8.0%	10.1%	15.9%	20.3%	17.4%	6.5%	6.5%
SAFETY	4.3%	2.2%	3.3%	4.3%	8.7%	10.9%	18.5%	23.9%	12.0%	12.0%
Invehicle Safety	3.5%	4.3%	5.0%	7.8%	2.8%	13.5%	14.9%	19.9%	14.9%	13.5%
Vehicle to O/D Security	5.8%	2.9%	6.5%	5.1%	10.9%	9.4%	22.5%	16.7%	9.4%	10.9%
TIME	8.3%	3.8%	6.8%	8.3%	10.5%	16.5%	10.5%	21.1%	6.8%	7.5%

5.5 DATA ANALYSIS

5.5.1 Introduction

The data was analysed using the Microsoft Excel 2000 software (Microsoft Corporation, 1985-1999). Multiple regression techniques were used to estimate satisfaction models for each of the 34 travel attributes defined in this thesis. For the overall satisfaction model, the proposed combination rule was employed to generate overall satisfaction values.

5.5.2 Descriptive Summary

A descriptive summary of the data is shown in Table 5.4 below. An examination of the table indicates that except for Weather Protection Satisfaction (WPSat), none of the other dependent variables (overall satisfaction and the attribute satisfactions) have skewness values greater than one. A skewness value greater than one is an indication of a distribution that differs significantly from the normal distribution (Cavana et al, 2001, p.413). Thus the assumption of normal distribution holds for these dependent variables. However, for WPSat, a log transformation will be required to correct for the skew.

Table 5.4 Descriptive Summary of Survey Data

Variable	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	MIN	MAX	Sum	Count
Age	1.76	0.08	1	1	1.10	1.22	0.77	1.36	4	1	5	289	164
Overall Satisfaction	6.55	0.15	7	7	2.01	4.05	0.21	-0.56	9	1	10	1075	164
Weather Protection Satisfaction	7.89	0.18	8	10	2.33	5.46	0.70	-1.14	9	1	10	1215.5	154
Clean Vehicle Satisfaction	5.18	0.20	5	5	2.49	6.21	-0.78	0.11	9	1	10	798	154
Temperature Control Satisfaction	4.52	0.23	4	1	2.88	8.30	-0.95	0.41	9	1	10	678	150
Fatigue Attention Satisfaction	5.26	0.19	5	5	2.25	5.09	-0.65	-0.16	9	1	10	674	128
Privacy Satisfaction	4.59	0.23	4	1	2.88	8.32	-0.89	0.45	9	1	10	680	148
Comfortable Seat Satisfaction	6.08	0.20	6	8	2.54	6.49	-0.82	-0.31	9	1	10	936.5	154
Smooth Ride Satisfaction	5.99	0.20	6	7	2.61	6.82	-0.68	-0.30	9	1	10	929	155
Leg Room Satisfaction	5.69	0.21	6	8	2.65	7.05	-0.92	-0.04	9	1	10	865.5	152
Noise Level Satisfaction	5.20	0.20	5	6	2.54	6.47	-0.87	-0.02	9	1	10	791.5	152
Crowd Satisfaction	4.51	0.22	4	1	2.74	7.55	-0.99	0.28	9	1	10	699.5	155
Seat Availability Satisfaction	5.21	0.21	5	7	2.59	6.75	-0.89	0.06	9	1	10	781.5	150
Available When Needed Satisfaction	5.94	0.20	6	6	2.60	6.77	-0.85	-0.18	9	1	10	915	154
Vehicular Transfers Satisfaction	5.88	0.22	6	8	2.46	6.09	-0.84	-0.24	9	1	10	742	126
WheelChair Space Satisfaction	5.10	0.25	5	1	2.96	8.77	-1.15	0.10	9	1	10	679	133
Entry Ease Satisfaction	6.61	0.20	7	8	2.49	6.24	-0.50	-0.57	9	1	10	991.5	150
Storage Space Satisfaction	5.42	0.20	5.5	7	2.58	6.70	-0.87	-0.13	9	1	10	825	152
Payment Ease Satisfaction	6.97	0.20	7	7	2.47	6.13	-0.06	-0.79	9	1	10	1025.5	147
Booking Ease Satisfaction	5.99	0.24	6	8	2.67	7.16	-0.71	-0.32	9	1	10	695.5	116
Vehicle-O/D Distance Satisfaction	6.14	0.19	6	7	2.35	5.52	-0.45	-0.35	9	1	10	872	142
User Constraints Satisfaction	5.96	0.20	6	7	2.24	5.04	-0.54	-0.18	9	1	10	751.5	126
Possible Destination	6.78	0.20	7	8	2.42	5.86	-0.35	-0.59	9	1	10	909.5	134

Variable	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	MIN	MAX	Sum	Count
Satisfaction													
Advanced Booking Satisfaction	5.81	0.23	6	7	2.57	6.63	-0.86	-0.20	9	1	10	674.5	116
Cost Satisfaction	5.75	0.23	6	7	2.86	8.21	-1.11	-0.20	9	1	10	828	144
Driver Attitude Satisfaction	6.18	0.21	7	7	2.63	6.95	-0.61	-0.49	9	1	10	928	150
Escort Attitude Satisfaction	5.77	0.28	6	5	2.96	8.81	-1.19	-0.16	9	1	10	641	111
Booking Staff Attitude Satisfaction	5.83	0.26	6	6	2.78	7.73	-0.91	-0.24	9	1	10	654	112
Route Information Satisfaction	6.78	0.20	7	8	2.39	5.74	-0.24	-0.60	9	1	10	936	138
Service Frequency Information Satisfaction	5.83	0.20	6	7	2.42	5.88	-0.74	-0.23	9	1	10	793.5	136
Arrival Time Information Satisfaction	5.67	0.21	6	8	2.56	6.55	-0.98	-0.18	9	1	10	806	142
Waiting Time Reliability Satisfaction	5.45	0.21	6	7	2.49	6.21	-0.89	-0.15	9	1	10	731	134
Travel Time Reliability Satisfaction	6.18	0.19	7	7	2.25	5.10	-0.39	-0.42	9	1	10	854	138
In-Vehicle Safety Satisfaction	6.84	0.20	7	8	2.47	6.14	-0.30	-0.73	9	1	10	965.5	141
Vehicle-O/D Security Satisfaction	6.46	0.21	7	7	2.47	6.14	-0.35	-0.60	9	1	10	891.5	138
Time Satisfaction	5.98	0.22	6	8	2.55	6.54	-0.69	-0.41	9	1	10	796	133
Weather Proct Importance	4.33	0.07	5	5	0.96	0.93	0.83	-1.28	4	1	5	676.5	156
CleanVeh Importance	4.17	0.08	5	5	1.07	1.15	0.76	-1.21	4	1	5	652	156
Temp Importance	3.42	0.09	3	3	1.16	1.36	-0.60	-0.33	4	1	5	524	153
FatigueAttn Importance	3.16	0.10	3	3	1.26	1.61	-0.79	-0.22	4	1	5	424	134
Privacy Importance	3.02	0.10	3	3	1.32	1.74	-1.04	-0.00	4	1	5	456.5	151
ComfortSeat Importance	4.04	0.09	4	5	1.13	1.29	1.95	-0.27	8	1	9	631	156
SmoothRide Importance	4.14	0.08	5	5	1.03	1.08	0.48	-1.06	4	1	5	647	156
LegRm Importance	3.91	0.08	4	5	1.09	1.20	-0.84	-0.55	4	1	5	607.5	155
Noise Importance	3.39	0.09	3	3	1.16	1.35	-0.75	-0.19	4	1	5	523.5	154
Crowd Importance	4.02	0.08	4	5	1.09	1.20	-0.25	-0.81	4	1	5	627.5	156
SeatAv Importance	4.19	0.08	5	5	0.99	0.99	0.32	-1.05	4	1	5	637.5	152
Avail Importance	4.45	0.07	5	5	0.88	0.77	2.17	-1.59	4	1	5	685.5	154

Variable	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	MIN	MAX	Sum	Count
VehTrans Importance	3.69	0.10	4	5	1.22	1.49	-0.43	-0.63	4	1	5	492	133
WChair Importance	3.46	0.13	4	5	1.55	2.42	-1.29	-0.47	4	1	5	481.5	139
EntryEase Importance	3.91	0.09	4	5	1.19	1.42	-0.16	-0.87	4	1	5	591	151
Storage Importance	3.62	0.09	4	5	1.17	1.37	-0.71	-0.45	4	1	5	559	154
PayEase Importance	3.91	0.09	4	5	1.13	1.28	-0.16	-0.79	4	1	5	579.5	148
BookEase Importance	3.57	0.10	4	3	1.19	1.43	-0.77	-0.35	4	1	5	447	125
VehOD Importance	3.82	0.09	4	5	1.16	1.36	-0.04	-0.80	4	1	5	558	146
UserCons Importance	3.72	0.09	4	5	1.12	1.26	-0.51	-0.48	4	1	5	481	129
PossDest Importance	4.12	0.09	4	5	1.05	1.10	1.42	-1.30	4	1	5	561	136
AdvBook Importance	3.43	0.12	4	5	1.37	1.89	-0.92	-0.48	4	1	5	426	124
Cost Importance	4.19	0.08	5	5	1.04	1.08	1.05	-1.24	4	1	5	616.5	147
DriverAt Importance	4.08	0.09	5	5	1.19	1.43	0.58	-1.21	4	1	5	625	153
EscortAt Importance	3.83	0.12	4	5	1.32	1.76	-0.39	-0.88	4	1	5	453	118
BkStfAt Importance	4.05	0.11	5	5	1.22	1.50	0.41	-1.18	4	1	5	474.5	117
RouteInfo Importance	4.30	0.08	5	5	1.02	1.04	1.68	-1.50	4	1	5	603	140
FreqInfo Importance	4.36	0.08	5	5	0.95	0.90	2.95	-1.73	4	1	5	603	138
ArrTimeInfo Importance	4.33	0.07	5	5	0.93	0.86	1.34	-1.35	4	1	5	624.5	144
WaitTime Importance	4.23	0.08	5	5	1.03	1.07	1.12	-1.30	4	1	5	576	136
TravTime Importance	4.29	0.07	5	5	0.91	0.83	0.54	-1.12	4	1	5	605	141
InVehSaf Importance	4.50	0.07	5	5	0.92	0.84	3.45	-1.95	4	1	5	640	142
VehODSec Importance	4.25	0.08	5	5	1.04	1.08	0.52	-1.18	4	1	5	591	139
Time Importance	4.00	0.09	4	5	1.10	1.23	-0.15	-0.84	4	1	5	541	135
Weather Prot LOS	3.52	0.09	3	3	1.26	1.58	0.31	1.03	5	1	6	578	164
CleanVeh LOS	2.09	0.11	1	1	1.50	2.26	-0.31	1.13	4	1	5	343	164
Temp LOS	2.78	0.07	2	2	1.01	1.02	-1.65	0.22	3	1	4	457	164
FatigueAttn LOS	3.14	0.09	2	2	1.26	1.61	-1.64	0.34	3	2	5	516	164
Privacy LOS	1.91	0.05	2	2	0.65	0.43	-0.68	0.09	2	1	3	314	164
ComfortSeat LOS	2.90	0.04	3	3	0.52	0.27	26.18	-5.13	4	0	4	477	164
SmoothRide LOS	3.09	0.02	3	3	0.34	0.12	10.43	0.51	3	1	4	507	164
LegRm LOS	2.42	0.03	2	2	0.49	0.24	-1.93	0.29	1	2	3	398	164
Noise LOS	2.14	0.02	2	2	0.34	0.12	2.40	2.09	1	2	3	351	164
Crowd LOS	1.98	0.07	2	2	0.96	0.93	0.64	0.72	4	0	4	326	164

Variable	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	MIN	MAX	Sum	Count
SeatAv LOS	2.07	0.08	2	2	1.02	1.04	0.06	0.68	4	0	4	340	164
Avail LOS	3.04	0.09	2	2	1.21	1.46	-1.39	0.52	3	2	5	499	164
VehTrans LOS	3.45	0.06	3	3	0.81	0.66	-0.21	1.30	2	3	5	567	164
WChair LOS	1.96	0.03	2	2	0.39	0.15	17.53	-3.27	3	0	3	322	164
EntryEase LOS	1.90	0.03	2	2	0.46	0.21	9.22	-2.49	3	0	3	313	164
Storage LOS	2.10	0.04	2	2	0.53	0.28	5.84	-1.10	3	0	3	345	164
PayEase LOS	1.73	0.04	2	2	0.59	0.35	2.66	-1.78	3	0	3	285	164
BookEase LOS	3.17	0.03	3	3	0.39	0.15	1.12	1.45	2	2	4	520	164
VehOD LOS	3.0	0.08	3	3	1.11	1.25	0.65	0.23	5	0	5	492	164
UserCons LOS	2.14	0.03	2	2	0.43	0.18	1.32	0.77	2	1	3	352	164
PossDest LOS	1.38	0.06	1	1	0.77	0.59	0.57	1.57	2	1	3	227	164
AdvBook LOS	4.86	0.04	5	5	0.54	0.30	20.93	-4.58	3	2	5	798	164
Cost LOS	3.61	0.15	5	5	1.97	3.89	-0.46	-1.13	5	0	5	593	164
DriverAt LOS	1.58	0.06	1	1	0.81	0.66	-0.73	0.55	3	0	3	260	164
EscortAt LOS	1.23	0.07	2	2	1.02	1.04	-1.69	-0.31	3	0	3	203	164
BkStfAt LOS	1.14	0.05	1	1	0.73	0.54	-0.20	0.22	3	0	3	188	164
RouteInfo LOS	2.60	0.03	3	3	0.49	0.24	-1.83	-0.42	1	2	3	427	164
FreqInfo LOS	1.93	0.02	2	2	0.34	0.11	28.73	-5.51	2	0	2	318	164
ArrTimeInfo LOS	1.25	0.04	1	1	0.51	0.26	-0.33	0.27	2	0	2	206	164
WaitTime LOS	3.38	0.06	3	3	0.77	0.59	0.57	1.57	2	3	5	555	164
TravTime LOS	2.98	0.02	3	3	0.27	0.07	10.99	-0.48	2	2	4	490	164
InVehSaf LOS	2.82	0.06	3	3	0.78	0.61	3.36	-1.23	4	0	4	463	164
VehODSec LOS	2.17	0.02	2	2	0.37	0.14	1.13	1.76	1	2	3	356	164
Time LOS	1.89	0.03	2	2	0.39	0.15	15.31	-3.97	2	0	2	311	164

5.5.3 Model Estimation

Satisfaction models were estimated for each of the 34 travel attributes, using the data collected. The dependent variable in each case (except the model for Weather Protection) was the attribute satisfaction measured on a scale of 1-10. For Weather Protection, the dependent variable was the natural logarithm of the attribute satisfaction (i.e. Ln WPSat) as a log transformation of this variable was required due to its distribution being significantly different from the normal distribution. The independent variables were the attribute level of service (**LOS**) and the user-characteristics. The attribute levels of service (**LOS**) are as indicated in Table 4.3. For each attribute, levels of service were ranked in increasing order of performance (starting from 1, better performance level has higher rank) and they are thus treated as ordinal variables. The user-characteristics are as follows:

1. **Age**: **1** = 0-19yrs; **2** = 20-39yrs; **3** = 40-59yrs; **4** = 60-79yrs; and **5** = 80+ yrs.
2. User Preference Value i.e. **Importance** (**Imp**), measured on a scale of 1 – 5.
3. **Gender**: Male = 1 and Female = 0.
4. Occupation dummy variables: **Worker**, **Student**, **Jobseeker** and **Retired**.
5. **Disabled**: Yes = 1 and No = 0.
6. Prior Transport Experience variables: Private Car (**PrCar**), Taxi/Minicabs (**Cab**), Community Transport/DaR (**CT_DaR**) and Public Transport (**PubTrans**). Experienced = 1 and Not Experienced = 0.

The ordinary least squares (OLS) technique was used to estimate the attribute satisfaction models. After running the regression, the plots of residuals against each explanatory variable were inspected for signs of heteroscedasticity and/or non-linearity.

For cross-sectional data such as these, heteroscedasticity is the rule rather than the exception (Gujarati, 1992; p. 327). Heteroscedasticity occurs when the assumption of constant error term variance is violated. When it occurs, OLS estimators are still linear and unbiased, but no longer have minimum variance and as such are no longer Best Linear Unbiased Estimators (BLUE). As the estimated variances are biased, interval estimation and hypothesis testing of significance of variables are adversely affected. Thus heteroscedasticity is a serious problem that needs to be identified and corrected. Wherever either heteroscedasticity or non-linearity was found to be present, it was corrected by transforming the variables as suggested by Bowers, 1991 and Gujarati, 1992.

Multicollinearity between the independent variables was also checked. It was expected there would be some correlation between the dummy variables of AGE and OCCUPATION. There was also, for some attributes, some correlation between the attribute LOS and some Prior Transport Experience variables. In the presence of multicollinearity, the OLS estimates are still Best Linear Unbiased Estimates (BLUE), consistent and asymptotically unbiased and efficient (Bowers, 1991). However, severe multicollinearity effects do produce large standard errors and thus significant variables could be indicated as not significant. Gujarati (1992) has stated, though, that for prediction purposes, multicollinearity is not "necessarily bad". He also states that with respect to estimating a group of coefficients – e.g. the sum or difference of two coefficients – multicollinearity does not hinder a "fairly accurate" estimation (Gujarati, 1992). Thus even though for some of the attribute satisfaction models, multicollinearity was present; its presence may disguise the significance of some variables, but it would not detract from the performance of the model.

After correcting for any violations of the OLS assumptions, for each travel attribute, the estimated models were compared, and selection was made, on the basis of their $\mathbf{R}^2$ and Adjusted $\mathbf{R}^2$ values. Following Gujarati (1992) and Alonso (1968), the principle of parsimony, i.e. as simple a model as possible, was also considered in making a selection of the "best" model. The results of the model estimation for each of the travel attributes are presented in Section 6.2 and the discussion on these results and their implications are presented in Chapter 8.

As these models are intended to be used as part of a decision support tool, it was also necessary to design a framework for such a decision support tool. The development of this framework is presented in the next section.

5.6 DECISION SUPPORT FRAMEWORK

5.6.1 Introduction

To enable the use of the proposed overall transport-user satisfaction model in decision-making, a decision support system is necessary. This section presents the development of the prototype for such a support system. A decision support system basically provides support to enable the decision-maker make decisions more easily. Thus such a system would simplify or conduct the more routine and time consuming aspects of the decision making process to enable the decision-maker concentrate on the critical and more sensitive act of choosing.

In this study, the kind of decisions to be made require rapid access to information on the client (i.e. the transport user), and on the transport services. Therefore, a suitable decision support system would consist of a relational database framework that would incorporate the developed transport satisfaction algorithm, information on user characteristics, and the characteristics of the available transport services, and an algorithm for the matching of user's mobility requirement to vehicle facility.

The interviews held with the managers and staff of the transport organisations provided information on the requirements and specifications for such a database system. They desired a system that would enable swift matching of client's mobility requirements with suitable transport vehicles and services with cost constraints, and also enable production of reports on operations for records and financial accountability to both trip sponsors and the management of the transport organisation. Thus in addition to the database of relevant information and the matching algorithm such as the Transport-User Satisfaction Model (TUSM) being developed in this thesis, the decision support system would need to incorporate a system of producing reports on and records of the services provided .

5.6.2 Framework Development

The structure of the relational database to be used in the proposed system was designed and developed using Microsoft Access – Designing a Database procedure. (Microsoft Corporation). The basic framework is centred on a user and vehicle-service database system and a pre-selection criteria matching passenger disability and vehicle capability. Provision was made for the inclusion of the transport-user satisfaction algorithm to introduce the user preference criteria in the final selection process. The algorithm, which will compute, for every transport choice available to the broker in response to a travel request from a user, a user-based transport satisfaction score, is based on the overall transport satisfaction function derived in this thesis (i.e. the TUSM).

The framework has been set up such that it requires minimal (and easy to obtain) data for the computation of the user satisfaction value for each transport service. (Note that transport service as used in this thesis incorporates the total transport service and not the vehicle alone). For each registered client, in addition to the socio-characteristic information, data required is simply an indication of his or her importance rating for every travel attribute of relevance to him or her. While for every registered vehicle, knowledge of its performance level for each attribute is the only requirement.

The relational database has been designed to be interactive, permitting the broker on discussion with a client to modify any of the client's stated preferences to either allow the selection of a compromise vehicle if the first selection process recommends a service that is unavailable for any reason or alter the client's preferences if he or she has changed their feelings about any of them. Also, dominating attributes such as wheelchair space for wheelchair users, police-cleared staff for special clients such as children in social care or staff gender preferences have been included in the pre-selection criteria that produces the list of suitable transport options for which a transport satisfaction value would be computed. An algorithm to rank the transport alternatives by their satisfaction scores is also included in the framework. The designed output format would enable the broker keep a record of the particular vehicle/service that a user has consistently preferred. It would also enable them to keep track of vehicles that consistently score low on users' satisfaction ratings and also enable them be in a position to advise operators on which attributes to improve on to increase patronage among his clients.

The concept of the framework is to have readily available, in database format, information on clients (details, preferences, sponsors) and vehicles (characteristics, services, operator details) and other information considered useful and relevant by the broker (based on the consultation with CT Operators). This information has been tabulated and linked with appropriate keys to enable efficient querying of the data to get the required information at any time. The relationships enable the database to yield, on query, a list of suitable vehicles to satisfy the criteria imposed by the broker.

Using the Structured Query Language (SQL), Select queries and Make Table queries were designed to impose the criteria. Forms were also designed to enable easy data entry and modification when it is necessary for the broker to adjust some of the criteria on discussion with the user so as to provide alternative transport options. The entire database was set up to ensure minimal interference with the programming code. The required input for the selection process is the user or client's identification number or name. A designed report produces the desired output – a list of suitable transport options sorted and ranked according to the satisfaction value computed for each using the Transport-User Satisfaction function. A secondary sorting based on cost is also included. The procedure for using this decision support tool is detailed in the process path and flow-chart in Section 5.6.3 below.

5.6.2.1 Tables

The following tables were designed and the information (fields) in each table are as shown in the Appendix (Appendix A.3).

1. Clients table.
2. Vehicles table.
3. Operators table.
4. Sponsors table.
5. Attributes Weightings (i.e. client details/ preferences) table.

5.6.2.2 *Forms*

For each of the above tables (except no. 5), a form was designed to enable easy data entry/modification. Any amendment of the client preferences in the Attributes Weights table would require the coordinator's direct intervention. If the client at any specific time/trip wishes to compromise or change temporarily his or her preferences, it would be done through a temporary table (Client Compromise) produced by a make-table query: 'Compromise' (see below). Thus there are four forms as follows:

1. Clients Form.
2. Vehicles Form.
3. Operators Form.
4. Sponsors Form.

5.6.2.3 *Queries*

Several queries were designed using the Structured Query Language (SQL) syntax. The SQL code for each query is shown in the Appendix (Appendix A.4). The queries are as follows:

1. Weights
2. Compromise
3. VehicleAttribute Satisfaction
4. Total Operation
5. Compromise Vehicle

The Weights query retrieves from the database, the weights applicable to the specific client based on his or her recorded preferences and computes the summation of attribute importance values (to be used as divisor in the TUSM algorithm in the Total Operation and CompromiseVehicle Queries).

The Compromise query is a 'Make Table' query and it retrieves into a table 'Client Compromise', the details of a specific client from the Clients table. This is to enable live modification of the client's details when the non-availability of a suitable vehicle makes it necessary for the client to make adjustments to his or her requirements (other than their attribute importance values).

The VehicleAttribute Satisfaction query retrieves information from the Attribute Weightings table and combines them with information from the Vehicles table to compute Satisfaction values for the travel attributes with respect to each vehicle for the client being attended to. The algorithm used for these computations are those developed for the Attribute Satisfaction (as presented in Section 6.2). These attribute satisfaction values would be inputs for the TUSM algorithm in the Total Operation and CompromiseVehicle Queries.

The Total Operation query retrieves information from the Vehicles, Operators and Clients tables and the Weights and the VehicleAttribute Satisfaction queries, to select a preliminary list of vehicles suitable for the client, based on a matching of the client's physical requirements and the vehicle characteristics. A satisfaction rating for each vehicle in the list is simultaneously computed using the TUSM algorithm (see Section 6.3). This rating is used to sort the list of vehicles in descending order. The secondary sort criterion is cost.

The Compromise Vehicle query is similar to the Total Operation query except that it replaces the Clients table with the Client Compromise table. The reason for the Client Compromise table and hence the Compromise Vehicle query is to enable a modification of the client's preferences as indicated in his or her records in the Client table to create more options of suitable vehicles if the list of suitable vehicles produced by the Total Operations query is unacceptable or unavailable.

5.6.2.4 Reports

In addition to the forms, queries and tables, two reports were designed to enable an operator-friendly output of the findings of the queries. These are

1. Vehicle Selection (first selection).
2. CompromiseVehicle Selection (compromise selection).

Each report outputs in tabular format, the list of suitable vehicles sorted primarily by their transport satisfaction value and then secondarily by their service costs. This output is meant to be an aid for the broker to make a choice of transport to provide for the client and also a record. A sample output is shown in the Appendix (A.5).

5.6.3 Process Path

The procedure of using this decision support tool is detailed in the process path below and the flowchart overleaf.

1. Take Phone Call and ask for Client's ID No.
   - If New Client, go to Step 2.
   - If Old Client but forgotten ID No., ask for surname and go to step 3.
   - Else go to step 4.

2. Open and fill in ClientForm and Sponsor Form, then go to step 4.

3. Open ClientForm and using FIND, search for records with that surname. Confirm ID No. with first name and age. Then go to Step 4.

4. Open Vehicle Selection Report and enter details of Client ID No.
   - If Report has nil records or unacceptable records, go to step 6.
   - Else go to Step 5.

5. Print Vehicle Selection Report. Select most satisfactory available vehicle. Confirm to client that booking has been made and go to Step 10.

6. Consult with Client to make amendments to preferences and then Run Compromise Query.

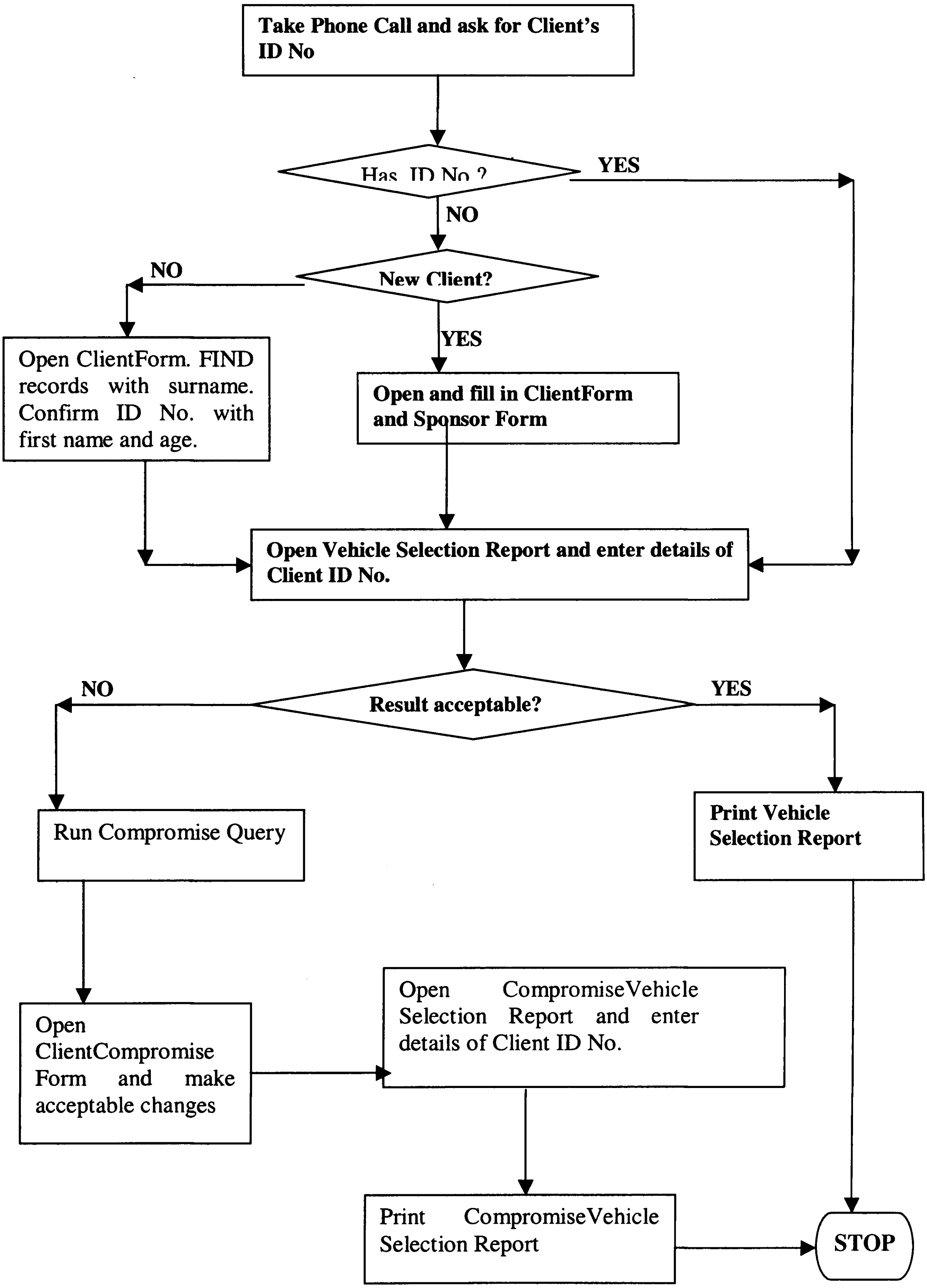
7. Open ClientCompromise Form and make acceptable changes.

8. Open CompromiseVehicle Selection Report and enter details of Client ID No.

9. Print CompromiseVehicle Selection Report. Select most satisfactory available vehicle. Confirm to client that booking has been made and go to Step 10.

10. End Call.

5.6.3.1 *Flowchart*



5.7 CONCLUSION

This chapter has presented the design and conduct of a survey for this study and the data-collection and data analyses processes for the development of the transport satisfaction models. It has also presented the development of a framework for the use of this model in a transport brokerage. The next chapter presents and discusses the developed satisfaction models.

CHAPTER 6

TRANSPORT SATISFACTION MODELS

6.1 INTRODUCTION

The previous chapter presented the design and conduct of a survey for this study and the data-collection and data analyses processes for the development of the transport satisfaction models. It also presented the development of a framework for the use of this model in a transport brokerage. This chapter presents the satisfaction models developed in this thesis and discusses the implications of the parameters estimated for the regression-based models as well as the overall transport satisfaction model. Section 6.2 presents the transport attribute satisfaction models, which were estimated by OLS regression. Section 6.3 presents the overall transport satisfaction model developed by a combination of the attribute satisfaction models and the chapter is concluded in Section 6.4.

The transport-user satisfaction model developed in this thesis consists of a two-stage modelling process. The two-stage modelling process attempts to represent the process a user could undergo in forming satisfaction after a transport experience. In the first stage, the user is assumed to see his or her transport experience as made up of contacts with only the attributes of the transport service which he or she considers relevant to their satisfaction with the transport service, thus they ignore the other attributes. Given the level of service available for each relevant attribute and the strength of the user's preference for the attribute, his or her contact with the attributes stirs up a particular level of satisfaction for each attribute within him or her. The second stage of the modelling process assumes that the user then combines these attribute satisfactions in a way that can be represented by a weighted-average linear algorithm into an overall transport satisfaction level that he or she considers to be the satisfaction they have for the transport service.

The attribute satisfaction models are thus sub-models of the overall transport satisfaction model. They estimate the satisfaction a user obtains for an attribute of the transport service. For a user, the relevant attributes are then combined according to the strength of his or her preferences, into an overall transport satisfaction value. This modelling approach can be represented as in Figure 6.1 below.

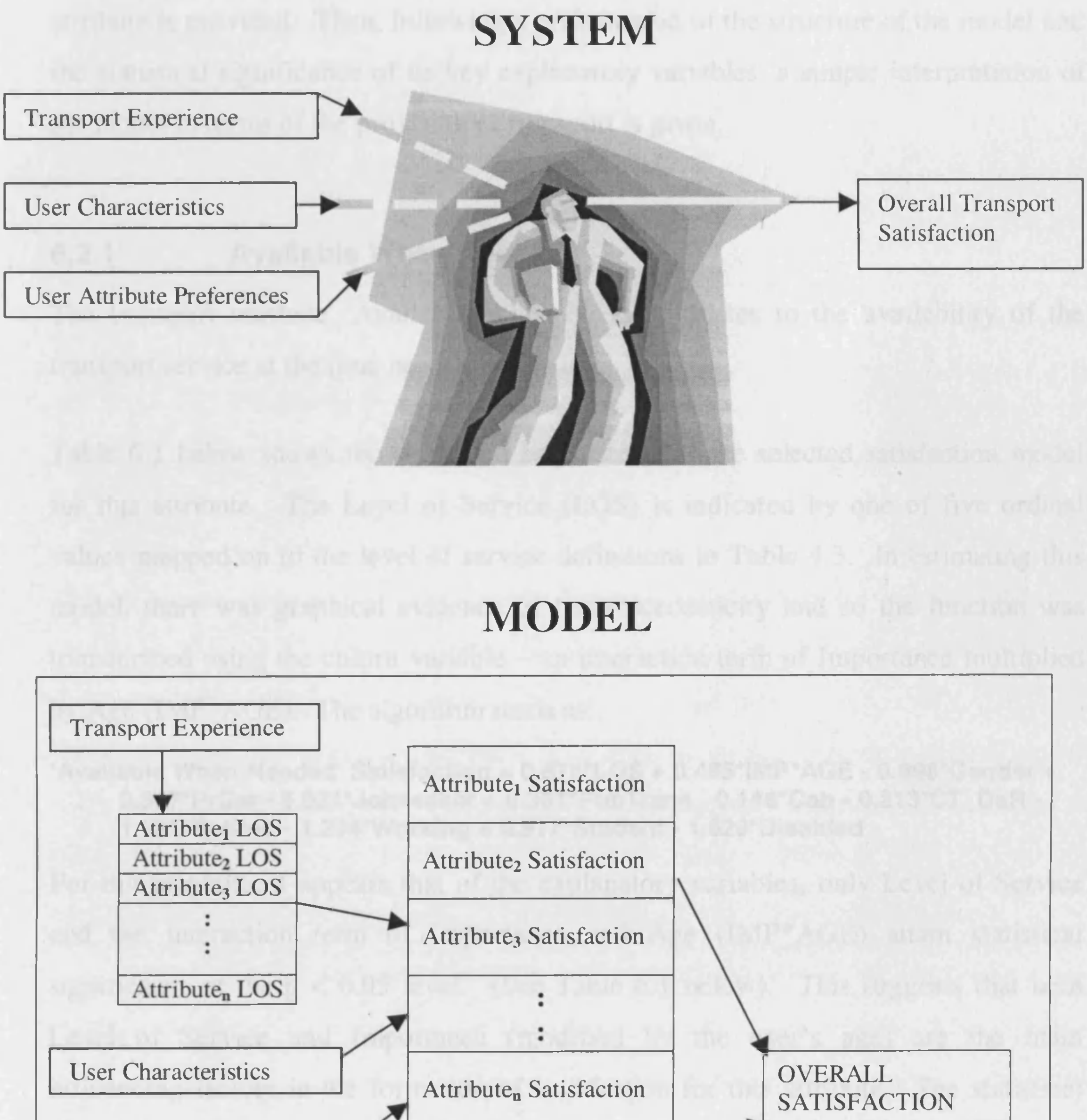


Figure 6.1 Transport-User Satisfaction – Model Vs. System

6.2 ATTRIBUTE SATISFACTION MODELS

In this section, the satisfaction prediction models derived for each transport attributes will be presented. There are 34 transport attributes and the presentation of the model for each of them will take the following pattern: First, a brief description of the attribute is provided. Then, following a presentation of the structure of the model and the statistical significance of its key explanatory variables, a simple interpretation of the model in terms of the provision of transport is given.

6.2.1 Available When Needed

The transport attribute 'Available When Needed' relates to the availability of the transport service at the time needed by the user.

Table 6.1 below shows the estimated parameters for the selected satisfaction model for this attribute. The Level of Service (LOS) is indicated by one of five ordinal values mapped on to the level of service definitions in Table 4.3. In estimating this model, there was graphical evidence of heteroscedasticity and so the function was transformed using the culprit variable – an interaction term of Importance multiplied by Age (IMP*AGE). The algorithm reads as:

'Available When Needed' Satisfaction = 0.875*LOS + 0.485*IMP*AGE - 0.898*Gender + 0.557*PrCar - 5.621*Jobseeker + 0.381*PubTrans - 0.146*Cab - 0.213*CT_DaR - 1.851*Retired - 1.234*Working + 0.917*Student - 1.620*Disabled

For this attribute, it appears that of the explanatory variables, only Level of Service and the interaction term of Importance and Age (IMP*AGE) attain statistical significance at the $p < 0.05$ level. (See Table 6.1 below). This suggests that both Level of Service and Importance (modified by the user's age) are the main influencing factors in the formation of satisfaction for this attribute. The statistical significance of Importance especially as modified by the user's age group implies a subjectivity in user response to the level of service for this attribute. Thus user individuality is quite influential and Level of Service on its own may not be sufficient in determining user satisfaction for this attribute.

In terms of transport provision, this model suggests that users who rate this attribute highly may be satisfied, for example, by providing a rapid response service.

Table 6.1 Available When Needed - Estimated Parameters

Variable	Coefficients	t Stat	P-value
Level of Service (LOS)	0.875	3.956	0.000
Importance multiplied by Age (IMP*AGE)	0.485	3.879	0.000
Gender	-0.898	-1.921	0.056
Private Car (PrCar)	0.557	0.801	0.424
Jobseeker	-5.621	-1.367	0.173
Public Transport (PubTrans)	0.381	0.423	0.672
Cab	-0.146	-0.340	0.734
Community Transport/Dial-A-Ride (CT_DaR)	-0.213	-0.131	0.895
Retired	-1.851	-0.560	0.575
Working	-1.234	-0.648	0.518
Student	0.917	0.672	0.502
Disabled	-1.620	-0.436	0.663
R^2 = 0.427; Adjusted R^2= 0.375; Std Err = 0.529 N = 154; F = 8.814 (sig. = 2.08E-12)			

6.2.2 Booking Staff Attitude

'Booking Staff Attitude' is one of three travel attributes relating to the behaviour of the transport service crew – in this case, the booking staff.

The estimated parameters for the selected satisfaction model for this attribute are shown in Table 6.2 below. For this model, the presence of heteroscedasticity was detected graphically and the function was transformed with the variable (AGE) that showed non-constant residual variance. The level of service was indicated by one of three ordinal values mapped on to the level of service definitions in Table 4.3. The algorithm for the attribute 'Booking Staff Attitude' reads as follows:

'Booking Staff Attitude' Satisfaction = 0.107*IMP^2 - 1.129*LOS - 0.189*Gender + 1.113*Age + 3.574*Student + 4.159*Working + 1.112*Jobseeker + 1.727*Retired + 1.426*PrCar + 0.113*Cab - 4.011*CT_DaR + 2.301*LOS/IMP - 0.780*PubTrans

For this attribute, it appears that of the explanatory variables, it is only Importance (squared) and an Occupation dummy variable (Student) that attain statistical significance at the $p<0.05$ level. This suggests that satisfaction on Booking Staff Attitude is affected mainly by the value to the user of having a helpful booking staff as well as by the effect of the user's occupation. The quadratic form of the Importance variable implies a disproportionate influence on satisfaction of changes in importance values. Again, the statistical significance of Importance and another user characteristic – Occupation – imply user subjectivity in satisfaction formation for this attribute.

This model suggests that different people at different stages of life would respond differently to the attitude of the booking staff. So appropriate training programs on customer relations should be provided for the booking staff.

Table 6.2 Booking Staff Attitude - Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance Squared (IMP^2)	0.107	2.465	0.015
Level of Service (LOS)	-1.129	-1.548	0.124
Gender	-0.189	-0.307	0.759
Age	1.113	0.971	0.333
Student	3.574	2.204	0.029
Working	4.159	1.463	0.146
Jobseeker	1.112	0.273	0.784
Retired	1.727	0.336	0.737
Private Car (PrCar)	1.426	1.555	0.122
Cab	0.113	0.219	0.826
Community Transport/Dial-A-Ride (CT_DaR)	-4.011	-1.798	0.075
Level of Service divided by Importance (LOS/IMP)	2.301	1.391	0.167
Public Transport (PubTrans)	-0.780	-0.673	0.501
R^2 = 0.359; Adjusted R^2= 0.271; Std Err = 2.24 N = 112; F = 4.261 (sig. = 1.29E-05)			

6.2.3 Clean Vehicle

The 'Clean Vehicle' attribute refers to the level of cleanliness of the transport vehicle.

Table 6.3 below shows the estimated parameters for the selected satisfaction model for this attribute. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the level of service definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'Clean Vehicle' Satisfaction = 6.474 - 2.151*LOS + 0.477*LOS^2- 0.190*Importance - 0.302*Gender + 0.482*Age + 0.269*Student + 0.853*Working + 2.000*Jobseeker + 0.780*Retired - 1.045*Disabled - 0.752*PrCar + 0.282*Cab - 1.364*CT_DaR - 0.066*PubTrans

For this attribute, it appears that only the attribute Level of Service, LOS and its squared term (LOS^2), attain statistical significance at the $p<0.05$ level. Thus, it could be said that satisfaction for the Clean Vehicle attribute is affected, mainly, by the level of cleanliness of the vehicle. The quadratic relationship suggests disproportionately large changes in satisfaction with changes in cleanliness levels. The non-significance of the individual characteristics of users seemingly suggests that individual differences between users are not influential in the formation of satisfaction with respect to the cleanliness of a transport vehicle.

This model suggests that transport providers should ensure that vehicles are always clean.

Table 6.3 Clean Vehicle - Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	6.474	2.634	0.009
Level of Service (LOS)	-2.151	-2.393	0.018
Level of Service squared (LOS^2)	0.477	2.891	0.004
Importance	-0.190	-1.014	0.312
Gender	-0.302	-0.749	0.454
Age	0.482	0.957	0.340
Student	0.269	0.153	0.878
Working	0.853	0.484	0.628
Jobseeker	2.000	0.830	0.407
Retired	0.780	0.375	0.708
Disabled	-1.045	-0.754	0.451
Private Car (PrCar)	-0.752	-1.069	0.286
Cab	0.282	0.720	0.472
Community Transport/Dial-A-Ride (CT_DaR)	-1.364	-0.876	0.382
Public Transport (PubTrans)	-0.066	-0.075	0.940
R^2 = 0.256; Adjusted R^2= 0.181; Std Err = 2.26 N = 154; F = 3.410 (sig. = 9.4E-05)			

6.2.4 Comfortable Seats

This attribute relates to the seats and the degree of comfort they provide.

In Table 6.4 below, the estimated parameters for the selected satisfaction prediction model for this attribute 'Comfortable Seats' are shown. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the Level of Service definitions in Table 4.3. For this model, there was also no graphical evidence of heteroscedasticity. The algorithm reads as:

'Comfortable Seats' Satisfaction = 8.343 + 0.425*LOS - 1.352*LOS/Imp - 0.522*Importance - 0.768*Student - 0.167*Working - 2.197*Disabled + 1.823*PrCar + 1.553*CT_DaR

For this attribute, it appears that only a dummy variable representing past transport experience (PrCar i.e. Private Car) attains statistical significance at the $p<0.05$ level. This suggests that satisfaction for this attribute is influenced mainly by a user's prior experience. For this variable, it thus seems that a comparison exercise is involved in the satisfaction formation process. This can be likened to the disconfirmation process discussed in Chapter 3 where the decision on satisfaction is influenced by the fulfillment (or not) of expectations by performance. Thus it could be that it is not so much the present comfort level of the seat that matters, but how that level compares with the user's other experiences of seat comfort.

This means that transport providers should try to ensure that the comfort of the seats on their vehicles is comparable to the best quality in the transport provision sector.

Table 6.4 Comfortable Seats - Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	8.343	4.778	4.29E-06
Level of Service (LOS)	0.425	0.899	0.369
Level of Service divided by Importance (LOS/IMP)	-1.352	-1.584	0.115
Importance	-0.522	-1.534	0.126
Student	-0.768	-1.053	0.293
Working	-0.167	-0.198	0.842
Disabled	-2.197	-1.583	0.115
Private Car (PrCar)	1.823	3.299	0.001
Community Transport/Dial-A-Ride (CT_DaR)	1.553	0.981	0.327
R^2 = 0.126; Adjusted R^2= 0.078; Std Err = 2.45 N = 154; F = 2.623 (sig. = 0.010355)			

6.2.5 Cost – Price Of Service

The attribute 'Cost" relates to the fare paid for the transport service.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.5 below. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the level of service definitions in Table 4.3. For this model, there was also no graphical evidence of heteroscedasticity. The algorithm for the 'Cost' attribute reads as:

'Cost' Satisfaction = 8.244 + 0.413*Importance - 2.898*LOS + 0.551*LOS^2 + 0.377*Gender - 1.234*Age - 1.054*Student - 3.068*Jobseeker + 4.292*Retired - 0.552*Cab + 0.732*PubTrans + 1.664*PrCar + 2.441*Working + 0.536*CT_DaR - 1.020*Disabled

It can be seen from Table 6.5 that, of the explanatory variables, it is the Level of Service (LOS), its squared term, (LOS^2), Age and PrCar (a past transport experience dummy variable – Private Car) that attain statistical significance at the $p<0.05$ level. A quadratic relationship with LOS is also evidenced – implying that there are disproportionately large changes in satisfaction with changes in the cost of the service. In addition to the influence of the actual cost of the service and the age of the user, a possible comparative assessment is also indicated here by the attainment of significance by the PrCar variable. This implies that a comparison exercise, which can be likened to disconfirmation, is involved in the satisfaction formation process for this variable. Perhaps the significance of Age may be because of the relationship of age with income rather than because of age itself – (income was not included as a variable in the model for the reasons suggested in Section 3.3.2).

This model suggests that the fare level for a transport service is very important in user satisfaction formation and that there is a need for providers to ensure their prices are competitive in comparison to other providers.

Table 6.5 Cost – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	8.244	3.193	0.001
Importance	0.413	1.781	0.077
Level of Service (LOS)	-2.898	-2.582	0.010
Level of Service squared (LOS^2)	0.551	2.886	0.004
Gender	0.377	0.754	0.452
Age	-1.234	-2.041	0.043
Student	-1.054	-0.487	0.627
Jobseeker	-3.068	-1.073	0.285
Retired	4.292	1.596	0.112
Cab	-0.552	-1.145	0.254
Public Transport (PubTrans)	0.732	0.815	0.416
Private Car (PrCar)	1.664	2.204	0.029
Working	2.441	1.112	0.268
Community Transport/Dial-A-Ride (CT_DaR)	0.536	0.289	0.772
Disabled	-1.020	-0.493	0.622
R^2 = 0.213; Adjusted R^2= 0.127; Std Err = 2.68 N = 144; F = 2.490 (sig. = 0.003688)			

6.2.6 Crowding

'Crowding' is an attribute that is directly influenced by the capacity of the transport vehicle, the frequency of the service and the level of travel demand.

Table 6.6 below shows the estimated parameters for the selected satisfaction model for this attribute. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the Level of Service definitions in Table 4.3. For this model, there was also no graphical evidence of heteroscedasticity. The algorithm reads as:

'Crowding ' Satisfaction = 8.596 - 0.722*Importance - 2.632*LOS/IMP + 1.655*LOS + 0.213*Gender + 0.350*Age - 3.129*Student - 1.899*Working - 3.297*Jobseeker - 2.516*Retired - 0.881*CT_DaR - 0.912*PubTrans - 0.256*PrCar - 0.040*Cab + 0.295*Disabled

From Table 6.6 below, it appears that of the explanatory variables, only the Level of Service (LOS) and the Importance of the attribute to the user (IMP) attain statistical significance at the $p<0.05$ level. Thus in addition to the influence of the level of crowding in the vehicle, the strength of the preference of the user towards crowding also affects satisfaction formation for this attribute. As in the case of the attribute 'Available When Needed' (Section 6.2.1), the statistical significance of Importance (IMP) here implies subjectivity in user satisfaction response to performance in this attribute. Thus this model indicates that user individuality is quite influential and performance on its own may not be sufficient in determining user satisfaction for this attribute.

This means that transport providers would need to be aware of the preferences of their clients in order to provide satisfactory services for them.

Table 6.6 Crowding – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	8.596	2.708	0.007
Importance	-0.722	-1.996	0.047
Level of Service divided by Importance (LOS/IMP)	-2.632	-1.805	0.073
Level of Service (LOS)	1.655	3.541	0.000
Gender	0.213	0.517	0.605
Age	0.350	0.663	0.508
Student	-3.129	-1.594	0.113
Working	-1.899	-0.966	0.335
Jobseeker	-3.297	-1.262	0.208
Retired	-2.516	-1.084	0.279
Community Transport/Dial-A-Ride (CT_DaR)	-0.881	-0.552	0.581
Public Transport (PubTrans)	-0.912	-1.230	0.220
Private Car (PrCar)	-0.256	-0.368	0.712
Cab	-0.040	-0.100	0.919
Disabled	0.295	0.199	0.841
R^2 = 0.329; Adjusted R^2= 0.262; Std Err = 2.36 N = 155; F = 4.898 (sig. = 2.51 E-07)			

6.2.7 Driver Attitude

This attribute, (Driver Attitude) relates to the behaviour of drivers of transport vehicles.

The estimated parameters for the selected satisfaction model are shown in Table 6.7 below. The Level of Service (LOS) was indicated by one of three ordinal values mapped on to the level of service definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity. The culprit variable was Age and thus the function was transformed using the square root of Age. Here, the algorithm reads as:

'Driver Attitude ' Satisfaction = 0.580*Importance + 0.060*LOS +0.972*Age - 0.458*Gender - 0.846*Jobseeker - 0.387*PubTrans + 2.123*CT_DaR - 1.063*Disabled + 0.129*PrCar - 0.081*Cab + 2.860*Working + 3.001*Student + 0.922*Retired

Table 6.7 below shows that only 'Student' (an Occupation dummy variable) and Importance attain statistical significance at the $p<0.05$ level. This suggests that the strength of preference of the user for the attribute and his or her occupation influence how a transport user forms satisfaction for this attribute. The statistical significance of Importance (IMP) and a user characteristic – Occupation – imply user subjectivity in satisfaction formation for this attribute.

This model suggests that different people at different stages of life would respond differently to the attitude of a driver. So appropriate training programs on customer relations should be provided for drivers.

Table 6.7 Driver Attitude – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.580	3.097	0.002
Level of Service (LOS)	0.060	0.160	0.872
Age	0.972	1.428	0.155
Gender	-0.458	-0.924	0.357
Jobseeker	-0.846	-0.286	0.774
Public Transport (PubTrans)	-0.387	-0.398	0.690
Community Transport/Dial-A-Ride (CT_DaR)	2.123	1.085	0.279
Disabled	-1.063	-0.492	0.623
Private Car (PrCar)	0.129	0.171	0.863
Cab	-0.081	-0.173	0.862
Working	2.860	1.539	0.126
Student	3.001	2.115	0.036
Retired	0.922	0.333	0.739
R^2 = 0.193; Adjusted R^2= 0.116; Std Err = 2.43 N = 150; F = 2.534 (sig. = 0.00378)			

6.2.8 Ease Of Booking Service

This attribute relates only to those transport modes that require pre-booking for a use of a vehicle for a trip and it refers to the process of booking a journey on a vehicle.

The estimated parameters for the selected model for this attribute 'Ease of Booking Service' are as shown in Table 6.8 below. The Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Importance) that showed residual variance. The algorithm reads as:

'Ease of Booking Service' Satisfaction = 0.802*Importance +1.718*LOS - 0.189*Gender - 1.405*Student - 2.228*Jobseeker - 2.900*CT_DaR - 0.885*Cab - 1.283*PrCar - 0.230*PubTrans + 1.120*Retired - 0.288*Age + 1.088*Disabled + 0.776*Working

For this attribute, it appears that of all the explanatory variables, only Importance, LOS and a past transport experience dummy variable – Private Car (PrCar) attain statistical significance at the $p<0.05$ level. This suggests that for this attribute, the strength of the user's preference, the level of performance and past transport experience all influence satisfaction formation. The co-attainment of significance by these three variables suggests that for this attribute, performance and a comparative evaluation (not unlike disconfirmation involving both expectations and desire) are actively influencing satisfaction formation.

This means that transport providers should take steps to ensure hat it is easy for everyone to use their pre-booking service. For example, making sure that there are enough telephone lines and operators would be useful.

Table 6.8 Ease Of Booking Service – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.802	4.702	8E-06
Level of Service (LOS)	1.718	3.564	0.000
Gender	-0.189	-0.425	0.671
Student	-1.405	-0.879	0.381
Jobseeker	-2.228	-0.763	0.447
Community Transport/Dial-A-Ride (CT_DaR)	-2.900	-1.950	0.053
Cab	-0.885	-1.768	0.080
Private Car (PrCar)	-1.283	-2.213	0.029
Public Transport (PubTrans)	-0.230	-0.307	0.759
Retired	1.120	0.521	0.603
Age	-0.288	-0.436	0.663
Disabled	1.088	0.509	0.611
Working	0.776	0.472	0.637
R^2 = 0.502; Adjusted R^2= 0.435; Std Err = 0.79 N = 116; F = 7.997 (sig. = 8.47E-11)			

6.2.9 Ease Of Entrance And Exit From Vehicle.

This attribute 'Ease of Entrance and Exit from Vehicle' is influenced both by the configuration of the transport vehicle and the terminus, and by the ability of the user.

For this attribute, the estimated parameters for the selected satisfaction prediction model are as shown in Table 6.9 below. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'Ease Of Entrance And Exit From Vehicle' Satisfaction = 7.153 + 0.211*Importance + 0.839*Age - 3.160*Jobseeker - 1.696*Retired - 1.799*Disabled - 1.490*PubTrans - 0.283*LOS^2

Table 6.9 below shows that of all the explanatory variables, only Age and a past transport experience dummy variable – Public Transport (PubTrans) attain statistical significance at the $p<0.05$ level. This suggests that age and a possible comparison activity relating the level of service with the user's past transport experience influence satisfaction formation for this attribute. This comparison activity may not be unlike the disconfirmation process described in Chapter 3.

This means that transport providers need to ensure that their vehicles are as up to date as possible in terms of access.

Table 6.9 Ease Of Entrance And Exit From Vehicle – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	7.153	4.653	7.41E-06
Importance (IMP)	0.211	1.222	0.223
Age	0.839	2.340	0.020
Jobseeker	-3.160	-1.816	0.071
Retired	-1.696	-1.313	0.191
Disabled	-1.799	-1.470	0.143
Public Transport (PubTrans)	-1.490	-2.049	0.042
Level of Service squared (LOS^2)	-0.283	-1.591	0.113
R^2 = 0.116; Adjusted R^2= 0.073; Std Err = 2.41 N = 150; F = 2.674 (sig. = 0.01249)			

6.2.10 Ease Of Payment (Method)

The attribute 'Ease of Payment' differs from the attribute 'Cost' as it refers to the method of payment and not the amount. Thus it is expected that satisfaction response to it would differ from the satisfaction response for the attribute 'Cost'.

The estimated parameters for the selected model are as shown in Table 6.10 below. Here the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'Ease of Payment Method' Satisfaction = 6.366 + 0.553*Importance - 0.607*LOS - 0.601*Gender + 0.199*Working - 3.362*Jobseeker + 0.771*Retired + 0.526*PrCar - 0.486*Cab - 1.601*CT_DaR

As can be seen in Table 6.10 below, it appears that of all the explanatory variables, only Importance attains statistical significance at the $p<0.05$ level. As expected satisfaction response for this attribute differs from the response for the attribute 'Cost'. While here, only Importance attains statistical significance, for 'Cost', it is Level of Service (LOS), Occupation and past transport experience variables that attain statistical significance. The results for this attribute suggest that it is the strength of the user's preference for this attribute that mainly influences his or her satisfaction for the attribute.

This suggests that transport providers should have a wide range of payment methods available for their clients to use.

Table 6.10 Ease Of Payment Method – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	6.366	5.891	2.81E-08
Importance (IMP)	0.553	3.170	0.001
Level of Service (LOS)	-0.607	-1.463	0.145
Gender	-0.601	-1.497	0.136
Working	0.199	0.360	0.719
Jobseeker	-3.362	-1.971	0.050
Retired	0.771	1.003	0.317
Private Car (PrCar)	0.526	0.894	0.372
Cab	-0.486	-1.202	0.231
Community Transport/Dial-A-Ride (CT_DaR)	-1.601	-1.094	0.275
R^2 = 0.148; Adjusted R^2= 0.092; Std Err = 2.36 N = 147; F = 2.638 (sig. = 0.00756)			

6.2.11 Escort Attitude

'Escort Attitude' is an attribute relating to the behaviour of escorts, who act as travel companions for those users less able to travel on their own or independently.

The estimated parameters for the selected model are as shown in Table 6.11 below. Here the Level of Service (LOS) was indicated by one of five ordinal values mapped on to the level of service definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm for this attribute reads as:

'Escort Attitude' Satisfaction = 5.173 + 0.921*Importance + 1.388*Retired + 0.835*PrCar - 1.332*PubTrans + 1.182*CT_DaR + 0.777*Disabled - 0.117*LOS - 0.098*Cab - 0.316*Age - 4.564*Jobseeker - 1.586*Student

It appears that of all the explanatory variables, only Importance and an Occupation dummy variable (Jobseeker) attain statistical significance at the $p<0.05$ level for this atrribute. (See Table 6.11 below). This suggests that it is the strength of the user's preference for this attribute and his or her occupation that mainly influence their satisfaction formation process for the attribute. The statistical significance of importance and a user characteristic – Occupation – imply user subjectivity in satisfaction formation for this attribute.

This model suggests that different people at different stages of life would respond differently to the attitude of an escort. So appropriate training programs on customer relations should be provided for escorts.

Table 6.11 Escort Attitude – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	5.173	1.939	0.055
Importance (IMP)	0.921	4.051	0.000
Retired	1.388	0.599	0.550
Private Car (PrCar)	0.835	1.037	0.302
Public Transport (PubTrans)	-1.332	-1.193	0.235
CT_DaR	1.182	0.540	0.590
Disabled	0.777	0.349	0.727
Level of Service (LOS)	-0.117	-0.390	0.697
Cab	-0.098	-0.179	0.858
Age	-0.316	-0.345	0.730
Jobseeker	-4.564	-1.985	0.049
Student	-1.586	-1.010	0.314
R^2 = 0.217; Adjusted R^2= 0.129; Std Err = 2.77 N = 111; F = 2.487 (sig. = 0.00845)			

6.2.12 Leg Room

Like the attribute 'Ease of Entrance and Exit from Vehicle', this attribute 'Leg Room' is influenced by both the vehicle configuration and the user's ability.

The estimated parameters for the selected model are as shown in Table 6.12 below. The Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'Leg Room' Satisfaction = 8.237 - 0.145*Importance - 0.509*Age - 1.969*Student - 3.215*Jobseeker - 3.094*Disabled + 1.269*PrCar + 0.181*Cab + 4.268*CT_DaR

As shown in Table 6.12, it appears that for this model, the following explanatory variables: Disabled, an Occupation dummy variable (Student) and past transport experience dummy variables of Private Car and Community Transport/Dial-A-Ride (PrCar and CT_DaR), attain statistical significance at the $p<0.05$ level. This suggests that satisfaction with this attribute is influenced by the user's disability status, and his or her occupation as well a comparison interaction with their prior transport experiences. The significance of disability here is not unexpected, as certain forms of disability would require adequate legroom for easy manoeuvrability. As stated previously, such comparison interactions as seen here are not unlike the disconfirmation process.

This means that transport providers need to ensure that their vehicles are as up to date as possible in terms of leg room space.

Table 6.12 Leg Room – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	8.237	5.375	3.04E-07
Importance (IMP)	-0.145	-0.753	0.452
Age	-0.509	-1.186	0.237
Student	-1.969	-2.266	0.024
Jobseeker	-3.215	-1.696	0.092
Disabled	-3.094	-2.369	0.019
Private Car (PrCar)	1.269	2.235	0.026
Cab	0.181	0.417	0.677
Community Transport/Dial-A-Ride (CT_DaR)	4.268	2.651	0.008
R^2 = 0.126; Adjusted R^2= 0.077; Std Err = 2.55 N = 152; F = 2.572 (sig. = 0.01187)			

6.2.13 Low Noise Level

The 'Low Noise Level' relates to the amount of noise in the transport vehicle during the trip.

For this attribute, the estimated parameters for the selected satisfaction prediction model are as shown in Table 6.13 below. In this case, the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. The algorithm reads as:

'Low Noise Level' Satisfaction = 0.266*Importance + 2.268*LOS - 0.506*Age - 0.412*Student + 1.870*Working + 1.997*Retired + 2.262*Disabled - 1.210*PrCar - 3.872*CT_DaR - 0.875*Jobseeker - 0.299*Cab - 0.151*Gender + 0.615*PubTrans

It can be seen in Table 6.13, that of all the explanatory variables, only level of service (LOS) attainsstatistical significance at the $p<0.05$ level. This suggests that the level of noise in the transport vehicle mainly influences satisfaction with this attribute. Thus for this attribute, performance is clearly the critical antecedent of satisfaction.

The transport provider may need to consider how the noise level inside their vehicles can be controlled. For example, by removing persistently noisy passengers to another vehicle.

Table 6.13 Low Noise Level – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance	0.266	1.499	0.135
Level of Service (LOS)	2.268	2.759	0.006
Age	-0.506	-0.571	0.568
Student	-0.412	-0.235	0.814
Working	1.870	0.796	0.427
Retired	1.997	0.474	0.635
Disabled	2.262	0.693	0.489
Private Car (PrCar)	-1.210	-1.592	0.113
Community Transport/Dial-A-Ride (CT_DaR)	-3.872	-1.907	0.058
Jobseeker	-0.875	-0.246	0.805
Cab	-0.299	-0.708	0.479
Gender	-0.151	-0.353	0.724
Public Transport (PubTrans)	0.615	0.783	0.434
R^2 = 0.338; Adjusted R^2= 0.273; Std Err = 2.09 N = 152; F = 5.450 (sig. = 6.83E-08)			

6.2.14 Minimal Advance Booking Time

This attribute refers to the amount of time required in advance to book transport to make a trip.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.14 below. The Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Importance) that showed residual variance. The algorithm reads as:

'Advance Booking Time' Satisfaction = 0.847*Importance + 0.493*LOS + 0.679*Age + 3.590*Working + 2.952*Retired +3.501*Disabled - 3.294*CT_DaR - 3.111*PubTrans + 2.033*Jobseeker + 3.059*Student - 0.680*Gender - 0.432*Cab - 1.971*PrCar

From Table 6.14, it appears that among the explanatory variables, it is only Importance, the Disabled variable and two past transport experience dummy variables (PubTrans and PrCar) that attain statistical significance at the $p<0.05$ level. This suggests that the strength of the users' preference for this attribute, their previous transport experiences and whether they are disabled or not are the main factors that influence satisfaction formation for this attribute. Thus in addition to personal characteristics and the preferences of the user, a comparison activity is involved in the satisfaction formation process for this attribute. As stated previously, such comparison activities are not unlike the disconfirmation process.

This suggests that transport providers should strive to offer a short advance booking period to their clients and that it would be sensible to be aware of (and react if appropriate) their competitors' approaches to this issue.

Table 6.14 Minimal Advance Booking Time – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance	0.847	5.450	3.45E-07
Level of Service (LOS)	0.493	0.957	0.340
Age	0.679	1.082	0.281
Working	3.590	1.492	0.138
Retired	2.952	1.045	0.298
Disabled	3.501	2.327	0.021
Community Transport/Dial-A-Ride (CT_DaR)	-3.294	-1.757	0.081
Public Transport (PubTrans)	-3.111	-5.944	3.82E-08
Jobseeker	2.033	0.568	0.570
Student	3.059	1.277	0.204
Gender	-0.680	-1.641	0.103
Cab	-0.432	-1.102	0.272
Private Car (PrCar)	-1.971	-3.485	0.000
R^2 = 0.647; Adjusted R^2= 0.596; Std Err = 0.85 N = 116; F = 14.52 (sig. = 7.43E-18)			

6.2.15 Minimal Constraints On Possible Users

This attribute is concerned with number of constraints (if any) which are used to decide who may use the transport service.

Table 6.15 below presents the estimated parameters for the selected satisfaction prediction model for this attribute. Here the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'User Constraints' Satisfaction = 2.238 + 0.155*IMP + 1.285*LOS - 0.239*Gender + 1.089*Working + 1.108*Retired - 2.459*Disabled + 0.370*PrCar + 0.346*Cab - 1.433*CT_DaR

For this attribute, it appears that of all the explanatory variables, only Level of Service (LOS) and an Occupation dummy variable (Working) attain statistical significance at the $p<0.05$ level. (See Table 6.15 below). This suggests that for this variable, it is mainly the service performance level and the user's Occupation that influence satisfaction formation. Here, performance (i.e. LOS) is clearly influencing satisfaction formation. Perhaps the significance of an Occupation variable is an indication of the influence of occupation-dictated travel needs on satisfaction formation.

This means that the transport provider should place as few constraints as possible on the eligibility to use their service.

Table 6.15 Minimal Constraints On Possible Users – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	2.238	1.430	0.155
Importance (IMP)	0.155	0.863	0.389
Level of Service (LOS)	1.285	2.075	0.040
Gender	-0.239	-0.595	0.552
Working	1.089	2.044	0.043
Retired	1.108	1.281	0.202
Disabled	-2.459	-1.716	0.088
Private Car (PrCar)	0.370	0.571	0.568
Cab	0.346	0.880	0.380
Community Transport/Dial-A-Ride (CT_DaR)	-1.433	-0.662	0.508
R^2 = 0.164; Adjusted R^2= 0.099; Std Err = 2.13 N = 126; F = 2.530 (sig. = 0.010968)			

6.2.16 Minimal Distance Between Origin/ Destination And Vehicle

This attribute relates to the walking distance the transport user has to cover when making a journey, whether at the beginning or at the end.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.16 below. For this attribute, the Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as:

'Minimal OD-Vehicle Distance' Satisfaction = 2.879 + 1.744*Importance - 0.214*IMP^2+ 0.933*LOS/IMP - 0.456*Gender + 0.828*Working + 0.308*Cab - 1.773*CT_DaR - 1.147*PubTrans + 0.385*Retired + 0.655*PrCar

As Table 6.16 indicates, it appears that none of the explanatory variables attain statistical significance at the $p<0.05$ level. Perhaps this could be attributed to the possible existence of multicollinearity amongst the explanatory variables. However at the $p < 0.1$ level of significance, an interaction term involving Level of Service (LOS) and Importance is statistically significant in influencing satisfaction formation for this attribute. This, coupled with the larger valued coefficient of Importance, would appear to suggest that Importance is influential in the satisfaction formation process for this attribute. This is quite plausible as, while the distance between a transport vehicle and an origin or destination is relevant, it is actually the perception of that distance in the mind of the user that is critical. Therefore, the interaction term of level of service and importance (LOS/IMP), i.e. LOS divided by IMP, could be representative of this relative value.

This model suggests that transport providers should check how important walking distance is to each of their clients and modify their services accordingly.

Table 6.16 Minimal OD-Vehicle Distance – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	2.879	1.238	0.217
Importance (IMP)	1.744	1.544	0.124
Importance squared (IMP^2)	-0.214	-1.439	0.152
Level of Service divided by Importance (LOS/IMP)	0.933	1.901	0.059
Gender	-0.456	-1.147	0.253
Working	0.828	1.440	0.152
Cab	0.308	0.800	0.425
Community Transport/Dial-A-Ride (CT_DaR)	-1.773	-1.100	0.272
Public Transport (PubTrans)	-1.147	-1.600	0.111
Retired	0.385	0.526	0.599

Private Car (PrCar)	0.655	1.054	0.293
R^2 = 0.174; Adjusted **R^2**= 0.111; Std Err = 2.22 N = 142; F = 2.769 (sig. = 0.003918)			

6.2.17 Minimal Transfers (Vehicles)

This attribute relates to the design of the network of transport routes relative to the origin and /or destination of the user.

In Table 6.17 below, the estimated parameters for the selected satisfaction prediction model for this attribute are presented. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. Here the Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Minimal Vehicle Transfer' Satisfaction = 0.089*Importance + 4.604*LOS - 0.652*LOS^2- 0.207*Gender - 1.117*Student - 5.138*Jobseeker + 0.533*PrCar - 2.093*PubTrans + 1.579*CT_DaR - 0.886*Retired + 0.385*Cab + 0.290*Age

Here, it appears that of all the explanatory variables, only performance variables i.e. Level of Service (LOS) and its squared term (LOS^2) attain statistical significance at the $p<0.05$ level. (See Table 6.17 below). This suggests that for this attribute, Level of Service is the major influence on satisfaction formation. Again, a quadratic relationship with level of service is indicated – implying that there are disproportionately large changes in satisfaction with changes in the Level of Service of this attribute. However, in this case, the quadratic effect is negative: -LOS^2. According to Johnson and Gustafsson (2000), a negative quadratic plot of performance versus satisfaction suggests that the attribute concerned is a 'basic' attribute for which great improvements would not increase satisfaction much, but for which even slight deteriorations in performance would greatly increase dissatisfaction. For such an attribute, efforts need to be made to prevent performance deteriorations.

This means that a transport provider must ensure that as far as possible, the network of their services does not rely on transfers between vehicles.

Table 6.17 Minimal Transfers (Vehicles) – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.089	0.472	0.637
Level of Service (LOS)	4.604	2.675	0.008
Level of Service squared (LOS^2)	-0.652	-2.477	0.014
Gender	-0.207	-0.450	0.653
Student	-1.117	-0.732	0.465
Jobseeker	-5.138	-1.678	0.095
Private Car (PrCar)	0.533	0.772	0.441
Public Transport (PubTrans)	-2.093	-1.684	0.094
Community Transport/Dial-A-Ride (CT_DaR)	1.579	0.782	0.435
Retired	-0.886	-0.272	0.785
Cab	0.385	0.849	0.397
Age	0.290	0.289	0.773
R^2 = 0.369; Adjusted R^2= 0.299; Std Err = 2.03 N = 126; F = 5.551 (sig. = 2.16E-07)			

6.2.18 No Fatigue Felt From Constant Attention Or Uncertainty

This attribute refers to the fatigue experienced by a transport user caused by having to maintain constant alertness during the trip or having some uncertainty about it (perhaps about which stop to get off at, or when to transfer, etc).

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.18 below. In this case, the Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. For this model, there was also graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. The algorithm reads as:

'No Fatigue' Satisfaction = 0.605*Importance + 1.576*Student + 1.995*Working + 2.816*Jobseeker + 0.557*Age - 0.405*PubTrans + 1.671*Retired + 0.243*LOS - 0.955*Disabled - 0.356*CT_DaR + 0.382*PrCar + 0.354*Cab + 0.336*Gender

The results in Table 6.18 below, indicate that of all the explanatory variables, only Importance attains statistical significance at the $p<0.05$ level. This suggests that it is the strength of the user's preference for this attribute that is the major influence in its satisfaction formation. Again, user subjectivity is seen to be influential in satisfaction formation for this attribute. This is not unexpected as this attribute is clearly qualitative in nature and highly related to the individual's preferences.

This means that a transport provider should ensure that their clients are kept fully informed about their journey at all times.

Table 6.18 No Fatigue – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.605	3.628	0.000
Student	1.576	1.049	0.295
Working	1.995	0.899	0.370
Jobseeker	2.816	0.678	0.498
Age	0.557	0.677	0.499
Public Transport (PubTrans)	-0.405	-0.485	0.628
Retired	1.671	0.379	0.705
Level of Service (LOS)	0.243	1.158	0.248
Disabled	-0.955	-0.212	0.831
Community Transport/Dial-A-Ride (CT_DaR)	-0.356	-0.197	0.844
Private Car (PrCar)	0.382	0.619	0.536
Cab	0.354	0.855	0.394
Gender	0.336	0.728	0.467
R^2 = 0.383; Adjusted R^2 = 0.310; St Err = 1.839 N = 128; F = 5.496; (significance = 1.19E-07)			

6.2.19 Possibility Of Adjusting The Temperature

This attribute relates to the maintenance of suitable temperature levels within the vehicle.

The estimated parameters for the selected model are as shown in Table 6.19 below. Here the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm would read as:

'Temperature Adjustment' Satisfaction = 4.475 + 0.207*Importance + 0.420*LOS - 0.198*Gender + 0.149*Age - 1.031*Student + 0.013*Working - 3.315*Jobseeker + 1.282*Retired - 3.079*Disabled + 1.414*PrCar + 0.289*Cab + 0.392*CT_DaR - 1.802*PubTrans

From Table 6.19 below, it appears that of all the explanatory variables, only past transport experience dummy variables of Private Car and Public Transport (PrCar and PubTran) attain statistical significance at the $p<0.05$ level. It would seem therefore, that for this attribute, it is not so much the available Level of Service that is influential in satisfaction formation, but the Level of Service relative to the user's prior transport experiences. Thus again, a comparison activity is evidenced. This comparison activity may not be unlike the disconfirmation process.

This means that not only should a transport providers ensure that their vehicle air-conditioning systems are maintained and kept in working order, but also to ensure that their own system performs better than their competitors.

Table 6.19 Temperature Adjustment – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	4.475	1.784	0.076
Importance	0.207	1.100	0.273
Level of Service (LOS)	0.420	1.727	0.086
Gender	-0.198	-0.422	0.672
Age	0.149	0.247	0.804
Student	-1.031	-0.531	0.595
Working	0.013	0.006	0.994
Jobseeker	-3.315	-1.264	0.208
Retired	1.282	0.536	0.592
Disabled	-3.079	-1.977	0.050
Private Car (PrCar)	1.414	2.107	0.036
Cab	0.289	0.640	0.522
Community Transport/Dial-A-Ride (CT_DaR)	0.392	0.224	0.822
Public Transport (PubTrans)	-1.802	-2.257	0.025
R^2 = 0.263; Adjusted R^2 = 0.192; St Err = 2.589 N = 150; F = 3.732; (significance = 4.3E-05)			

6.2.20 Possible Destinations (Route)

The attribute 'Possible Destination (Route)' relates to the routing of the transport service.

For this attribute, the estimated parameters for the satisfaction prediction model are as shown in Table 6.20 below. For this model, there was graphical evidence of heteroscedasticity and thus the function was transformed with the variable (Importance) that showed residual variance. The Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as follows:

'Possible Destinations' Satisfaction = 0.906*Importance + 0.838*LOS - 0.393*Gender - 0.687*Age + 4.474*Retired - 1.873*Disabled - 0.223*PrCar - 1.734*CT_DaR + 0.348*PubTrans + 2.805*Working + 1.507*Jobseeker + 2.609*Student + 0.542*Cab

It appears that, only Importance, Level of Service (LOS), and Occupation variables (Retired, Working, and Student) attain statistical significance at the $p<0.05$ level. This suggests that for this attribute, it is the Level of Service and the user's strength of preference and Occupation, that mainly influence satisfaction. The statistical significance of these user characteristics implies that user subjectivity is influential in satisfaction formation for this attribute as well as is the attribute's level of service.

This means that a transport operator should ensure that they offer the widest possible range of destinations to their clients.

Table 6.20 Possible Destinations – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.906	6.859	3.14E-10
Level of Service (LOS)	0.838	2.255	0.025
Gender	-0.393	-0.853	0.394
Age	-0.687	-1.360	0.176
Retired	4.474	2.096	0.038
Disabled	-1.873	-0.789	0.431
Private Car (PrCar)	-0.223	-0.310	0.756
Community Transport/Dial-A-Ride (CT_DaR)	-1.734	-0.676	0.500
Public Transport (PubTrans)	0.348	0.459	0.646
Working	2.805	2.132	0.035
Jobseeker	1.507	0.642	0.521
Student	2.609	2.406	0.017
Cab	0.542	1.421	0.157
R^2 = 0.406; Adjusted R^2 = 0.339; St Err = 0.633 N = 134; F = 6.370; (significance = 4.91E-09)			

6.2.21 Protection From Weather

'Protection from Weather' is an attribute that is related to the design of the transport infrastructure such as a bus shelter.

The estimated parameters for the satisfaction model for this attribute are as shown in Table 6.21 below. (Note that the dependent variable is the natural log of Weather Protection Satisfaction). The Level of Service (LOS) was indicated by one of six ordinal values mapped on to definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Importance) that showed residual variance. The algorithm reads as:

'Weather Protection' Satisfaction = EXP (0.004*Imp + 0.174*LOS + 0.113*Age + 0.943*Jobseeker + 0.082*Gender + 1.217*Student + 0.892*Working + 0.716*Retired + 0.221*Disabled + 0.062*PubTrans + 0.077*Cab - 0.175*PrCar - 0.490*CT_DaR)

For this model, only level of service (LOS) and Occupation variables (Jobseeker, Working, and Student) attain statistical significance at the p<0.05 level. This suggests that, it is the user's Occupation, and the service performance level (LOS) that mainly influence satisfaction for this attribute. In addition to the user-subjectivity, which the significance of user occupation implies, there is a suggestion of occupation-dictated travel needs influencing satisfaction formation here. Perhaps for this attribute, this could mean that the need, for instance, not to appear disheveled or wet on arrival at a destination may vary from occupation to occupation.

This means that transport providers should be concerned about the passenger infrastructure, which their clients have to use when travelling on their services.

Table 6.21 Protection From Weather – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (Imp)	0.004	0.149	0.881
Level of Service (LOS)	0.174	4.496	1.43E-05
Age	0.113	1.202	0.231
Jobseeker	0.943	2.568	0.011
Gender	0.082	1.049	0.295
Student	1.217	8.071	2.76E-13
Working	0.892	3.933	0.000
Retired	0.716	1.949	0.053
Disabled	0.221	0.841	0.401
Public Transport (PubTrans)	0.062	0.505	0.613
Cab	0.077	0.959	0.338
Private Car (PrCar)	-0.175	-1.221	0.223
Community Transport/Dial-A-Ride (CT_DaR)	-0.490	-1.614	0.108
R^2 = 0.724; Adjusted R^2 = 0.693; St Err = 0.118 N = 154; F = 28.45; (significance = 5.63E-33)			

6.2.22 Routes Information

This attribute is one of three relating to information provision with respect to the transport service.

For its selected satisfaction prediction model, the estimated parameters are as shown in Table 6.22 below. There was no graphical evidence of heteroscedasticity with this model. For this attribute, the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Routes Information' Satisfaction = 3.454 + 0.791*Importance + 0.379*LOS + 0.077*Gender - 0.100*Age + 0.300*Working - 2.919*Jobseeker + 0.280*Retired + 0.388*PrCar - 3.711*CT_DaR - 1.074*PubTrans

As seen in Table 6.22, it appears that of all the explanatory variables, only Importance and a past transport experience dummy variable – Community Transport/Dial-a-Ride (CT_DaR) attain statistical significance at the $p<0.05$ level. This suggests that it is the strength of preference and past experience that influence satisfaction for this attribute. Here again, user-subjectivity is present. There is also an implication of a comparison activity (not unlike disconfirmation) being involved in satisfaction formation.

This model suggests that transport providers should know the preferences of their client with respect to the information they provide about their routes – including both before and during the journey.

Table 6.22 Routes Information – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	3.454	2.170	0.031
Importance (IMP)	0.791	3.901	0.000
Level of Service (LOS)	0.379	0.829	0.408
Gender	0.077	0.182	0.855
Age	-0.100	-0.196	0.844
Working	0.300	0.346	0.729
Jobseeker	-2.919	-1.711	0.089
Retired	0.280	0.168	0.866
Private Car (PrCar)	0.388	0.625	0.532
Community Transport/Dial-A-Ride (CT_DaR)	-3.711	-2.196	0.029
Public Transport (PubTrans)	-1.074	-1.222	0.223
R^2 = 0.161; Adjusted R^2 = 0.095; St Err = 2.281 N = 138; F = 2.432; (significance = 0.010995)			

6.2.23 In-Vehicle Safety

The travel attribute 'In-Vehicle Safety' relates to the degree of the risk of accidents and attacks from other users that a transport user has while he or she is inside the transport vehicle.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.23 below. In this case, the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as follows:

'In-Vehicle Safety' Satisfaction = 3.147 - 6.809*LOS/IMP + 0.465*LOS^2 + 14.998/Imp - 2.173*Jobseeker + 0.305*Gender + 1.500*CT_DaR - 0.716*Disabled + 0.749*PubTrans

From Table 6.23, it appears that of the explanatory variables, it is the Level of Service (through its squared term: LOS^2), the inverse of Importance and the interaction between Level of Service and Importance – Level of Service divided by Importance (LOS / Imp) that attain statistical significance at the $p<0.05$ level. The presence of the quadratic term in performance level of service (LOS^2) indicates a disproportionate change in satisfaction with changes in performance. Here, again, the influence of user-subjectivity on satisfaction formation is indicated. This model suggests that while performance is influential, the more important a user considers in-vehicle safety, the less likely he or she would be satisfied with whatever level of in-vehicle safety exists.

This means that transport providers, in addition to providing safety systems in their vehicles, should also strive to reassure their clients of the high levels of safety provided by their systems.

Table 6.23 In-Vehicle Safety – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	3.147	1.885	0.061
Level of Service divided by Importance (LOS/IMP)	-6.809	-2.815	0.005
Level of Service squared (LOS^2)	0.465	3.334	0.001
Inverse of Importance (INVImp)	14.998	2.264	0.025
Jobseeker	-2.173	-1.281	0.202
Gender	0.305	0.722	0.471
Community Transport/Dial-A-Ride (CT_DaR)	1.500	0.936	0.350
Disabled	-0.716	-0.566	0.572
Public Transport (PubTrans)	0.749	0.905	0.366
R^2 = 0.136; Adjusted R^2 = 0.084; St Err = 2.372 N = 141; F = 2.609; (significance = 0.011089)			

6.2.24 Seat Availability

'Seat Availability' attribute relates both to the vehicle capacity and the service frequency relative to the demand.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.24 below. For this model, there was also no graphical evidence of heteroscedasticity. Here the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Seat Availability' Satisfaction = 7.768 - 0.133*Imp + 0.846*LOS + 0.506*Gender - 0.054*Age - 3.794*Student - 2.358*Working - 3.809*Jobseeker - 1.951*Retired - 2.351*Disabled + 0.517*PrCar - 0.227*Cab + 2.437*CT_DaR - 0.416*PubTrans

Looking at Table 6.24 below, it appears that, it is only LOS that attains statistical significance at the $p<0.05$ level. This implies that it is Level of Service that mainly influences satisfaction for this attribute. The non-significance of user characteristics seemingly suggests that individual differences do not affect user satisfaction with seat availability in a transport vehicle. This is unusual, as one would expect that different groups of people would have different reactions to this. Perhaps the p-value for the variable 'Disabled' (0.077) may be suggestive of a possible disguised significance of a user characteristic. This is especially so given that the low representation of the disabled group in this study may be the reason for the non-significance (at $p<0.05$) here.

This significance of only performance suggests that concentrating on improving seat availability, either by increasing the fleet size or by better allocation of existing vehicles would be a sensible move for a transport provider.

Table 6.24 Seat Availability – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	7.768	2.641	0.009
Importance (IMP)	-0.133	-0.683	0.495
Level of Service (LOS)	0.846	2.953	0.003
Gender	0.506	1.292	0.198
Age	-0.054	-0.103	0.917
Student	-3.794	-1.533	0.127
Working	-2.358	-0.965	0.336
Jobseeker	-3.809	-1.268	0.206
Retired	-1.951	-0.721	0.471
Disabled	-2.351	-1.780	0.077
Private Car (PrCar)	0.517	0.735	0.463
Cab	-0.227	-0.577	0.564
Community Transport/Dial-A-Ride (CT_DaR)	2.437	1.564	0.120
Public Transport (PubTrans)	-0.416	-0.607	0.544
$\mathbf{R^2}$ = 0.302; Adjusted $\mathbf{R^2}$ = 0.236; St Err = 2.271 N = 150; F = 4.539; (significance = 2.07E-06)			

6.2.25 Security Between Vehicle And Origin/Destination

This travel attribute relates to the degree of the risk of accidents and personal attacks that a transport user has while he or she is moving between the transport vehicle and the trip's origin or destination.

For this attribute, the estimated parameters for the selected model are as shown in Table 6.25 below. Here, there was no graphical evidence of heteroscedasticity. Here the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Vehicle-OD Security' Satisfaction = - 0.867 - 0.980*LOS/IMP + 2.969*LOS + 1.657*Student + 2.207*Working + 2.146*Retired - 0.898*PrCar

As can be seen in Table 6.25 below, it appears that of all the explanatory variables, it is only level of service (LOS) that attains statistical significance at the $p<0.05$ level; suggesting it is this that mainly influences satisfaction for this attribute. The non-significance of user individual characteristics seems to suggest that individual differences do not affect user satisfaction with this attribute; which is unusual as one would expect Importance to be significant as in the case for the attribute 'In-Vehicle Safety' since like safety, security could be considered to be a qualitative attribute.

This means that the transport provider should ensure that the service is able to collect and deliver people as close as possible to their origin and destination, which suggests that network and service design are important.

Table 6.25 Vehicle-O/D Security – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	-0.867	-0.386	0.699
Level of Service divided by Importance (LOS/IMP)	-0.980	-1.281	0.202
Level of Service (LOS)	2.969	3.318	0.001
Student	1.657	1.480	0.141
Working	2.207	1.838	0.068
Retired	2.146	1.506	0.134
Private Car (PrCar)	-0.898	-1.164	0.246
R^2 = 0.112; Adjusted R^2 = 0.071; St Err = 2.389 N = 138; F = 2.75075 (significance = 0.01499)			

6.2.26 Sense Of Privacy

'Sense of Privacy' is another qualitative attribute of travel experienced by a transport user.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.26 below. In this case, the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was no graphical evidence of heteroscedasticity. The algorithm reads as follows:

'Sense of Privacy' Satisfaction = 4.831 + 0.071*Importance + 0.394*LOS - 0.343*Gender + 0.691*Age - 1.048*Student + 0.216*Working - 0.368*Jobseeker - 1.836*Retired + 0.413*Disabled + 1.170*PrCar + 0.192*Cab - 0.094*CT_DaR - 1.803*PubTrans

In Table 6.26, it can be seen that of the explanatory variables, only a past transport experience dummy variable – Public Transport (PubTrans) attains statistical significance at the p<0.05 level. This suggests that for this attribute, satisfaction is mainly influenced by comparison with the user's previous transport experience. This comparison activity is not unlike disconfirmation. Thus it is not as much the level of service provided here, as it is the user's assessment of that performance in comparison with his or her previous experiences that influences the satisfaction formation for this attribute.

This means that people will compare the proposed service with their previous experience in terms of their feeling of privacy. Transport providers should therefore be well-advised to ensure that their services match their competitors in this regard.

Table 6.26 Privacy – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	4.831	1.380	0.169
Importance (IMP)	0.071	0.416	0.677
Level of Service (LOS)	0.394	0.846	0.399
Gender	-0.343	-0.744	0.458
Age	0.691	1.184	0.238
Student	-1.048	-0.387	0.699
Working	0.216	0.080	0.935
Jobseeker	-0.368	-0.112	0.910
Retired	-1.836	-0.618	0.537
Disabled	0.413	0.261	0.794
Private Car (PrCar)	1.170	1.739	0.084
Cab	0.192	0.436	0.663
Community Transport/Dial-A-Ride (CT_DaR)	-0.094	-0.054	0.956
Public Transport (PubTrans)	-1.803	-2.094	0.038
R^2 = 0.303; Adjusted R^2 = 0.236; St Err = 2.522 N = 148; F = 4.4875 (significance = 2.61E-06)			

6.2.27 Service Frequency Information

Service Frequency Information is another information attribute.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.27 below. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Importance) that showed residual variance. Here Level of Service (LOS) was indicated by one of two ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Service Frequency Information' Satisfaction = 0.793*Imp + 2.164*Age - 1.386*Jobseeker - 2.382*CT_DaR - 3.570*PubTrans - 0.465*Working - 0.520*Gender - 2.380*Retired - 0.084*Disabled + 0.0131*PrCar + 0.438*Cab + 0.499*LOS + 2.308*Student

From Table 6.27, it appears that of all the explanatory variables, it is Importance, Age, a past transport experience dummy variable – Public Transport (PubTrans) and Student (an Occupation dummy variable) that attain statistical significance at the $p<0.05$ level. This suggests that for this attribute, it is user's preference and person (occupation and age) that mainly influence satisfaction. Thus user-subjectivity appears to the major influence here. A comparative activity is also involved in the satisfaction formation process. The non-statistical significance of Level of Service (LOS) here can not be assumed to suggest that performance is not important as it is involved in the comparative exercise. Thus perhaps, this case could be likened to the case where performance is indirectly influencing satisfaction through a disconfirmation process.

Transport providers should ensure that their information is up to date and understandable and compatible with their competitor's information provision.

Table 6.27 Service Frequency Information – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.793	6.454	2.26E-09
Age	2.164	5.094	1.28E-06
Jobseeker	-1.386	-0.699	0.485
Community Transport/Dial-A-Ride (CT_DaR)	-2.382	-1.189	0.2367
Public Transport (PubTrans)	-3.570	-3.858	0.000
Working	-0.465	-0.389	0.697
Gender	-0.520	-1.318	0.189
Retired	-2.380	-1.265	0.208
Disabled	-0.084	-0.048	0.961
Private Car (PrCar)	0.013	0.020	0.983
Cab	0.438	1.189	0.236
Level of Service (LOS)	0.499	0.938	0.350
Student	2.308	3.597	0.000
R^2 = 0.661; Adjusted R^2 = 0.621; St Err = 0.562 N = 136; F = 18.51 (significance = 4.62E-23)			

6.2.28 Smooth Ride

This attribute 'Smooth Ride' is influenced by factors such as the skill and training of the driver, as well as the condition of the vehicle and the surface on which it runs.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.28 below. Here the le Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Importance) that showed residual variance. The algorithm reads as:

'Smooth Ride' Satisfaction = - 0.038*Importance + 1.353*LOS - 1.279*Gender + 0.593*Age - 0.754*Student + 0.125*Working - 2.309*Jobseeker - 1.746*Retired - 2.604*Disabled + 2.538*PrCar - 0.351*Cab + 5.219*CT_DaR + 2.298*PubTrans

Looking at Table 6.28, it appears that the following explanatory variables: Level of Service (LOS), Gender and past transport experience dummy variables – Private Car (PrCar), Community Transport/Dial-a-Ride (CT_DaR) and Public Transport (PubTrans) attain statistical significance at the $p<0.05$ level. This suggests that it is mainly Level of Service and a comparative processing of performance against past experience that influence satisfaction in addition to the gender of the user. The significance of Gender suggests that males and females respond differently in forming satisfaction for this attribute – Smooth Ride. From the sign of the coefficient, it appears that males are less likely to be satisfied than females. Perhaps this could be due to gender differences in attitudes to how a vehicle is driven or even knowledge of how a vehicle should be driven. The non-statistical significance of Importance and its low coefficient value suggests that people may not vary much in the strength of preference they hold for this attribute.

This means that not only is driver training and vehicle maintenance critical, it is important for a transport provider to ensure that they are at least comparable to their competitors in this regard.

Table 6.28 Smooth Ride – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	-0.038	-0.277	0.781
Level of Service (LOS)	1.353	3.209	0.001
Gender	-1.279	-3.218	0.001
Age	0.593	1.180	0.239
Student	-0.754	-0.533	0.594
Working	0.125	0.085	0.932
Jobseeker	-2.309	-0.816	0.415
Retired	-1.746	-0.898	0.370
Disabled	-2.604	-1.491	0.138
Private Car (PrCar)	2.538	3.977	0.000
Cab	-0.351	-0.832	0.406
Community Transport/Dial-A-Ride (CT_DaR)	5.219	2.683	0.008
Public Transport (PubTrans)	2.298	3.883	0.000
R^2 = 0.621; Adjusted R^2 = 0.582; St Err = 0.682 N = 155; F = 17.91 (significance = 7.09E-24)			

6.2.29 Storage Space For Luggage, Shopping Bags

The attribute 'Storage Space' is related to the design of the transport vehicle interior.

The estimated parameters for the selected satisfaction prediction model are as shown in Table 6.29 below. For this model, there was no graphical evidence of heteroscedasticity. Here the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Storage Space' Satisfaction = 3.865 + 0.213*Importance + 0.348*LOS + 0.510*Age - 0.562*Student - 2.836*Jobseeker - 0.921*Retired - 2.737*Disabled + 1.323*PrCar - 0.741*Cab + 2.577*CT_DaR

In Table 6.29, it can be seen that of all the explanatory variables, only a past transport experience dummy variable – Private Car (PrCar) attains statistical significance at the $p<0.05$ level. This suggests that it is mainly past experience that influences satisfaction with this attribute. Thus there is a comparative exercise here, which could be likened to the disconfirmation process. Perhaps an assessment of satisfaction with respect to Storage Space in a transport vehicle can only really be made in relation to a user's previous experience or expectations.

This means that users will think about previous journeys when considering their need for storage space. Transport providers should check how they perform in this regard in comparison with their competitors.

Table 6.29 Storage Space – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	3.865	2.114	0.036
Importance (IMP)	0.213	1.186	0.237
Level of Service (LOS)	0.348	0.718	0.473
Age	0.510	0.918	0.360
Student	-0.562	-0.628	0.530
Jobseeker	-2.836	-1.535	0.126
Retired	-0.921	-0.691	0.490
Disabled	-2.737	-1.966	0.051
Private Car (PrCar)	1.323	2.034	0.043
Cab	-0.741	-1.773	0.078
Community Transport/Dial-A-Ride (CT_DaR)	2.577	1.561	0.120
R^2 = 0.151; Adjusted R^2 = 0.090; St Err = 2.468 N = 152; F = 2.502 (significance = 0.00851)			

6.2.30 Time - In-Vehicle Time

This attribute 'In-Vehicle Time' relates to the period of time a user spends in the vehicle while making the trip.

The estimated parameters for the selected satisfaction prediction model for this attribute are as shown in Table 6.30 below. In this case, the Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. For this model, there was graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. The algorithm reads as:

'In-Vehicle Time' Satisfaction = - 0.459*LOS + 0.179*Imp + 5.130*Student - 0.630*PubTrans + 0.862*Age - 0.184*Gender + 0.933*Cab + 4.867*Jobseeker 5.368*Working - 1.546*CT_DaR + 4.166*Retired + 0.239*PrCar - 0.542*Disabled

Looking at Table 6.30, it appears that of all the explanatory variables, only Student (an Occupation dummy variable) attains statistical significance at the $p<0.05$ level. The occurrence of high p-values for many of the other variables suggests the presence of multicollinearity amongst the explanatory variables. Perhaps, therefore, other variables could be significant, but their effect is masked by the presence of multicollinearity. Still the significance of this occupation variable implies the importance of user-subjectivity in satisfaction formation for this attribute. It also implies that there may be occupation-dictated travel needs that are linked to this attribute's performance. This is especially so as a look at the estimated coefficients of the variables indicate that the occupation variables are larger in value than the other variables.

This means that a transport provider should try to make sure that in-vehicle time is not unnecessarily prolonged

Table 6.30 In-Vehicle Time – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Level of Service (LOS)	-0.459	-0.732	0.465
Importance (IMP)	0.179	0.809	0.420
Student	5.130	3.002	0.003
Public Transport (PubTrans)	-0.630	-0.557	0.578
Age	0.862	0.806	0.421
Gender	-0.184	-0.354	0.723
Cab	0.933	1.834	0.069
Jobseeker	4.867	0.910	0.364
Working	5.368	1.894	0.060
Community Transport/Dial-A-Ride (CT_DaR)	-1.546	-0.694	0.488
Retired	4.166	0.724	0.469
Private Car (PrCar)	0.239	0.287	0.773
Disabled	-0.542	-0.144	0.885
R^2 = 0.591; Adjusted R^2 = 0.349; St Err = 2.338 N = 133; F = 4.958 (significance = 6.6E-07)			

6.2.31 Travel Time Reliability

The attribute 'Travel Time Reliability' is one of two attributes related to the reliability of the transport service. (See Section 6.2.33 for the other). It is specifically related to the variation in the length of the travel time.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.31 below. Here the Level of Service (LOS) was indicated by one of four ordinal values mapped on to the definitions in Table 4.3. For this model, there was also graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. The algorithm would read as:

'Travel Time Reliability' Satisfaction = 0.163*Importance + 0.788*LOS + 0.473*Cab + 2.899*Working + 1.859*Retired - 1.597*Disabled + 1.940*CT_DaR + 0.266*PubTrans + 0.123*Age + 0.260*Gender + 2.661*Jobseeker - 0.195*PrCar + 2.354*Student

From Table 6.31, it appears that none of the explanatory variables attain statistical significance at the $p<0.05$ level. However, this could be attributed to the presence of multicollinearity amongst the explanatory variables especially with the occurrence of high p-values for most of the other explanatory variables. However looking at the coefficients for the variables, the Occupation variables are seen to have higher values, and thus more influence on the satisfaction value. Again this could be suggestive of the existence of occupation-dictated travel needs linked to this attribute. Perhaps the need to be certain of the predictability of the total travel time could be more crucial in certain occupations than others.

This suggests that a transport provider needs to take all possible steps to ensure that services are consistent in terms of the travel time.

Table 6.31 Travel Time Reliability – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.163	0.649	0.517
Level of Service (LOS)	0.788	1.275	0.204
Cab	0.473	1.122	0.263
Working	2.899	1.079	0.282
Retired	1.859	0.390	0.696
Disabled	-1.597	-0.465	0.642
Community Transport/Dial-A-Ride (CT_DaR)	1.940	0.981	0.328
Public Transport (PubTrans)	0.266	0.308	0.758
Age	0.123	0.137	0.890
Gender	0.260	0.586	0.558

Jobseeker	2.661	0.553	0.581
Private Car (PrCar)	-0.195	-0.289	0.772
Student	2.354	1.049	0.296
R^2 = 0.439; Adjusted R^2 = 0.377; St Err = 2.047 N = 138; F = 7.516 (significance = 9.26E-11)			

6.2.32 Vehicle Arrival Time Information

This attribute is one of the three related to information. It is the arrival time of the vehicle at the point of pick-up.

The estimated parameters for the selected satisfaction prediction model for it are as shown in Table 6.32 below. For this model, there was also graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. Here the Level of Service (LOS) was indicated by one of two ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Vehicle Arrival time Information' Satisfaction = 0.300*Importance + 0.714*LOS + 0.345*Gender + 1.225*Age + 3.463*Student + 2.456*Working + 0.706*Jobseeker + 1.386*Retired - 0.382*Disabled + 0.191*PrCar + 0.191*Cab - 0.411*CT_DaR - 1.943*PubTrans

From Table 6.32, it appears that of all the explanatory variables, only Student (an Occupation dummy variable) and a past transport experience dummy variable – Public Transport (PubTrans) attain statistical significance at the $p<0.05$ level. However, the high p-values for some of the other explanatory variables suggest the presence of multicollinearity amongst the explanatory variables. So perhaps, there are other significant variables that have been disguised. Again, here, occupation is seen to be influential in satisfaction formation for this attribute as well as a comparative exercise. Thus user-subjectivity is also influential for this attribute. As stated previously about user-subjectivity, its significance implies that the use of performance alone in measuring satisfaction is inadequate.

This means that transport providers must provide their clients with accurate and updated arrival time information.

Table 6.32 Vehicle Arrival Time Information – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.300	1.183	0.238
Level of Service (LOS)	0.714	1.266	0.207
Gender	0.345	0.606	0.545
Age	1.225	1.342	0.181

Student	3.463	2.139	0.034
Working	2.456	0.926	0.355
Jobseeker	0.706	0.180	0.857
Retired	1.386	0.266	0.790
Disabled	-0.382	-0.103	0.917
Private Car (PrCar)	0.191	0.267	0.789
Cab	0.191	0.412	0.680
Community Transport/Dial-A-Ride (CT_DaR)	-0.411	-0.188	0.850
Public Transport (PubTrans)	-1.943	-2.033	0.044
R^2 = 0.319; Adjusted R^2 = 0.248; St Err = 2.274 N = 142; F = 4.647 (significance = 1.63E-06)			

6.2.33 Waiting Time (For Pick-Up) Reliability

This is the second of the attributes related to the reliability of the transport service. It specifically refers to the variation in the waiting time for the transport vehicle.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.33 below. In this case, the Level of Service (LOS) was indicated by one of five ordinal values mapped on to the definitions in Table 4.3. For this model, there was also graphical evidence of heteroscedasticity and the function was transformed with the variable (Age) that showed residual variance. The algorithm reads as:

'Waiting Time Reliability' Satisfaction = 0.306*Importance + 0.793*LOS + 1.311*Retired - 1.164*PrCar - 0.555*PubTrans + 0.537*Gender + 0.129*Age + 1.480*Student + 1.540*Working + 3.855*Jobseeker + 0.070*Disabled + 0.419*Cab + 1.797*CT_DaR

Just as was the case for the other reliability-related attribute, it appears that here, none of the explanatory variables attains statistical significance at the p<0.05 level. (See Table 6.33 below). However, this could also be attributed to the presence of multicollinearity amongst the explanatory variables especially with the occurrence of high p-values for most of the other explanatory variables. So perhaps, there are significant variables that have been disguised. The p-value of 0.059 for performance (LOS) here in a model with obvious multicollinearity effects, is such that the role of performance in satisfaction formation for this attribute cannot be overlooked. However looking at the coefficients for the variables, the Occupation variables are seen to have high values, and thus some influence on the satisfaction value. Again, as in the case with Travel Time Reliability, this could be suggestive of the existence of occupation-dictated travel needs linked to this attribute. Perhaps the need to be certain of the predictability of the waiting time could be more crucial in certain occupations than others.

This suggests that a transport provider needs to take all possible steps to ensure that services are consistent in terms of the waiting time for pick-up.

Table 6.33 Waiting Time Reliability – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Importance (IMP)	0.306	1.317	0.190
Level of Service (LOS)	0.793	1.901	0.059
Retired	1.311	0.258	0.796
Private Car (PrCar)	-1.164	-1.508	0.134
Public Transport (PubTrans)	-0.555	-0.510	0.610
Gender	0.537	1.095	0.275
Age	0.129	0.130	0.896
Student	1.480	0.740	0.460
Working	1.540	0.573	0.567
Jobseeker	3.855	0.780	0.436
Disabled	0.070	0.019	0.984
Cab	0.419	0.912	0.363
Community Transport/Dial-A-Ride (CT_DaR)	1.797	0.857	0.392
R^2 = 0.357; Adjusted R^2 = 0.285; St Err = 2.195 N = 134; F = 5.178 (significance = 2.96E-07)			

6.2.34 Wheel-Chair Space

'Wheel-Chair Space' attribute relates to whether or not there is a wheel chair space in the vehicle.

The estimated parameters for its selected satisfaction prediction model are as shown in Table 6.34 below. For this model, there was no graphical evidence of heteroscedasticity. The Level of Service (LOS) was indicated by one of three ordinal values mapped on to the definitions in Table 4.3. The algorithm reads as:

'Wheel-Chair Space' Satisfaction = 2.230 + 0.343*LOS*IMP - 2.489*LOS + 0.997*Gender + 0.798*Age + 2.143*Student + 2.295*Working - 1.342*Jobseeker + 0.654*Retired - 2.404*Disabled - 0.503*Cab + 3.590*CT_DaR + 2.156*PubTrans

Looking at Table 6.34 below, it appears that of all the explanatory variables, it is Level of Service (LOS), its interaction with Importance (LOS * IMP) i.e. level of service multiplied by Importance, and a past transport experience dummy variable – Public Transport (PubTrans) that attain statistical significance at the $p<0.05$ level. This suggests that satisfaction with this attribute is influenced by Level of Service directly, Level of Service mediated by the strength of the user's preference and by his or her past experience. Thus it appears that here, both Level of Service (i.e. performance) and user characteristics and a disconfirmation-like process are involved in the formation of satisfaction for this attribute.

This means that a transport provider should ensure that not only do they provide a wheelchair space; but also that they make sure that it is as appropriate as possible for each client (e.g. the type of wheel chair restraint, the wheelchair user's seatbelt design etc.) They would also need to ensure that for this attribute, their vehicles are as up to date as possible to match or keep ahead of their competitors.

Table 6.34 Wheel-Chair Space – Estimated Parameters

Variable	Coefficients	t Stat	P-value
Intercept	2.230	0.807	0.420
Level of Service multiplied by Importance (LOS*IMP)	0.343	3.656	0.000
Level of Service (LOS)	-2.489	-2.971	0.003
Gender	0.997	1.939	0.054
Age	0.798	1.099	0.273
Student	2.143	1.017	0.310
Working	2.295	1.072	0.285
Jobseeker	-1.342	-0.478	0.633
Retired	0.654	0.247	0.804
Disabled	-2.404	-1.316	0.190
Cab	-0.503	-1.000	0.319
Community Transport/Dial-A-Ride (CT_DaR)	3.590	1.264	0.208
Public Transport (PubTrans)	2.156	2.010	0.046
R^2 = 0.191; Adjusted R^2 = 0.111; St Err = 2.792 N = 133; F = 2.375 (significance = 0.00877)			

6.3 TRANSPORT-USER SATISFACTION MODEL

A suitable combination rule for overall satisfaction was determined using the user stated values for overall transport satisfaction, and the user stated values for the attributes' satisfaction – both obtained independently from the questionnaire survey as described in Section 5.2.3. Non-linear combination rules were not investigated here, as studies by Anderson and others (Anderson, 1981) have shown that linear models best represent judgemental processes. As discussed in Section 4.3.3, a weighted averaging function was fitted to the data. Evenly distributed random functions ranging from 1 to 10 were also compared with the data (100 runs of the random function were conducted).

The weighted averaging function had a better fit with a correlation coefficient of 0.61 compared to a linear additive function (correlation coefficient = 0.58). The correlation coefficients for the random functions ranged from -0.26 to 0.20. Thus the values from the weighted averaging function cannot be said to be random or guess work being more closely related to the user-stated values than the random values. The good fit of the weighted averaging function here and its improvement (though slight) on the linear additive function is not unexpected, as this combination rule has generally been found to be very suited to judgemental responses (Eagly and Chaiken, 1993; and Anderson, 1981).

Therefore, the selected combination rule for individual attribute satisfaction values is: $\Sigma(W_i*AS_i)/\ \Sigma W_i$. Thus, the Transport-User Satisfaction Model (TUSM) can be stated as:

$$\mathbf{SAT_{TUSM} = \Sigma(W_i*AS_i)/\ \Sigma W_i}$$

where

W_i is the user's stated weight for attribute i and

AS_i is the estimated satisfaction level for the attribute i for that user.

The inclusion of the user-defined weights in the function creates an individual user-specific function for the overall satisfaction measure. Using this model, overall satisfaction values were computed for each respondent in the dataset using the attribute satisfaction values estimated by the attribute satisfaction models. These values were compared with the user-stated overall satisfaction values and there was a significant relationship (correlation coefficient = 0.43; p<0.00) between them.

Recall Figure 2.2, (reproduced below as Figure 6.2). The TUSM algorithm derived above sits in the box for the Satisfaction Criteria. In the context of the decision support framework developed in Section 5.6, this criteria provides the first selection step as described for the Total Operation Query.

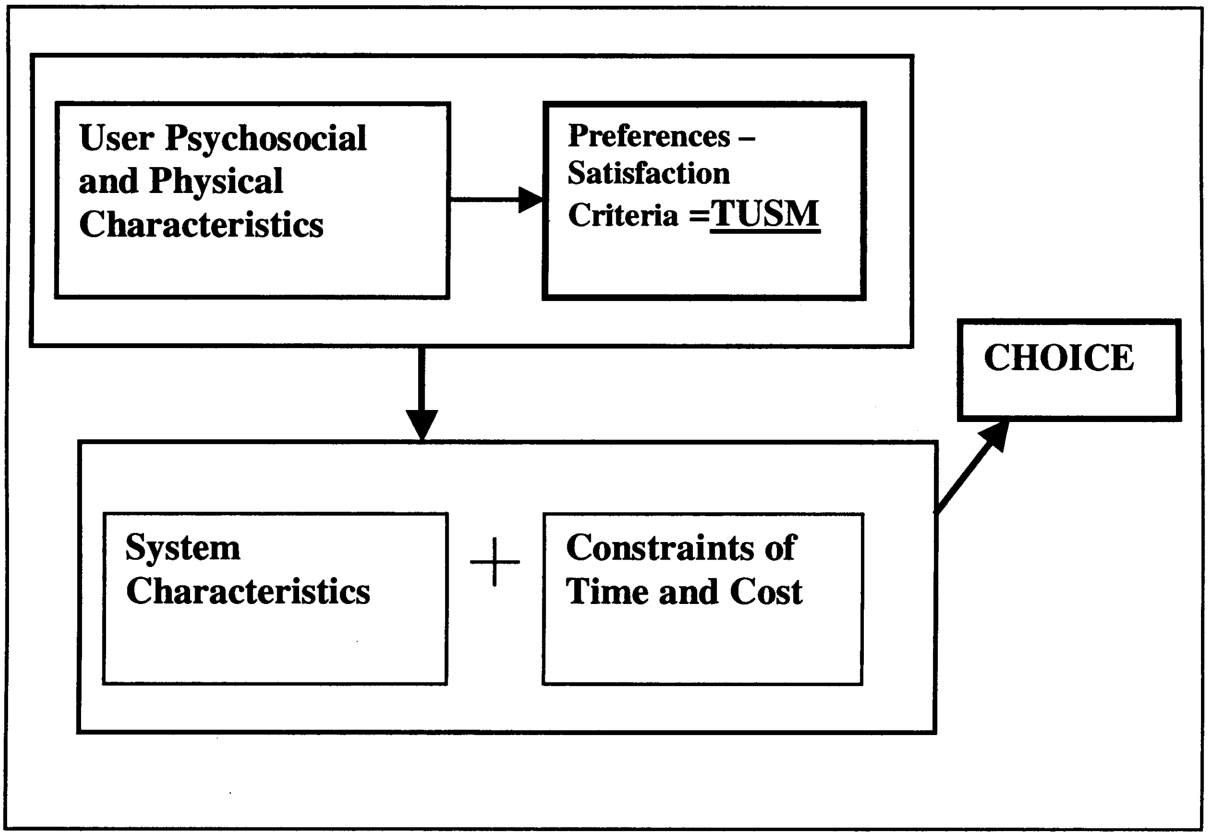


Figure 6.2 TUSM within the Proposed Vehicle Selection Process

6.4 CONCLUSION

This chapter has presented the estimated models for travel attribute satisfaction, and the overall transport satisfaction model. These models were derived on the basis of the transport satisfaction formulation proposed in Chapter 3, using the methods described in Chapter 4 and the data collected as described in Chapter 5.

The F-tests for the regression models for attribute satisfaction indicate statistical significance for the models. This provides support for the use of the primary satisfaction factors (see Figures 3.1 and 3.4) in the place of the established antecedents of satisfaction in developing predictive satisfaction models. The successful combination of the attribute satisfaction models by the weighted averaging rule also provides support for the use of Anderson's Information Integration technique in transport satisfaction modelling.

The amount of variance in transport attribute satisfaction that the estimated models explain range from 11.2% – 72.4%. There are no available similar models in transport against which these results can be compared. However, it can be said that for models developed based on 'social-science' type research, these results are not unusual. The wide range in the explained variance also suggests that the attributes differ in terms of their dependency on the explanatory variables. For the attributes at the lower end of the range, other factors (than those currently investigated) influence satisfaction formation to a greater extent than for attributes at the upper end of the range. The implications deducible from the forms of the attribute satisfaction models and the variables that attain statistical significance in them will be further discussed in Chapter 8.

The next chapter will present the tests of the hypotheses proposed in Chapter 3 and the model validation process. A model performance measure will also be derived for assessing the confidence level at which the overall transport satisfaction model can be used.

CHAPTER 7

HYPOTHESIS TESTING AND MODEL VALIDATION

7.1 INTRODUCTION

The previous chapter presented the estimated models for travel attribute satisfaction, and the overall transport satisfaction model. These models were derived on the basis of the transport satisfaction formulation proposed in Chapter 3, using the methods described in Chapter 4 and the data collected as described in Chapter 5.

Having estimated these models, the hypotheses proposed in the thesis (Section 3.3.3) can now be tested. In addition to testing the hypotheses, it is important to consider how well these models would perform in "out-of-sample" conditions. This assessment is conducted by the means of a model validation process.

Therefore, in this chapter the proposed hypotheses will be tested. Model validation processes will also be reviewed and the application of such processes to the models in this thesis will be considered and where applicable, the models will be taken through a validation process to ascertain how well they represent the satisfaction formation process in transport users. A model performance measure will also be derived for assessing the confidence level at which the overall transport satisfaction model can be used.

7.2 HYPOTHESIS TESTING

In this section, the three null hypotheses proposed in Section 3.3.3 of this thesis will be tested. The null hypotheses are as follows:

1. The independent variables do not significantly explain the variation in attribute satisfaction.

i.e. H_{o1}: $R^2_i = 0$

H_{a1}: $R^2_i \neq 0$

Where R^2_i is the explained variance for the regression of Attribute (i) on the independent variables.

2. There is no significant relationship between Sat_{TUSM} and Sat_{user}.

i.e. H_{o2}: $\rho_{m:u} = 0$

H_{a2}: $\rho_{m:u} \neq 0$

Where $\rho_{m:u}$ is the correlation coefficient between Sat_{TUSM} and Sat_{user}.

3. There is no significant difference between Sat_{TUSM} and Sat_{user}.

i.e. H_{o3}: $Sat_{TUSM} = Sat_{user}$.

H_{a3}: $Sat_{TUSM} \neq Sat_{user}$.

7.2.1 Hypothesis 1: $R^2_i = 0$

This hypothesis is set up to test whether the independent variables used in the model estimation can explain satisfaction formation for travel attributes. This is important to know because current customer satisfaction models do not utilise these independent variables. Rather the antecedents of satisfaction: Performance, Expectation and Disconfirmation (PED) are used as independent variables. Unfortunately, in the development and utilization of a practical decision model such as the TUSM, these variables (PED) are difficult to measure and use. However, the independent variables used (see Section 5.5.3) in this thesis (which form the basic factors influencing PED) are easier to measure and use.

The test for this hypothesis is the F-test for regression significance as it indicates whether the R^2 value of the regression equation i.e. whether the amount of variance in attribute satisfaction explained by the regression equation is significantly different from zero or not. As shown in Table 7.1 below, the F-test for each attribute satisfaction model (Section 6.2) is significant at the $p < 0.05$ level. For this reason, the null hypothesis H_{o1} is rejected and the alternative hypothesis H_{a1} is accepted. It can be said therefore that, for the transport attributes, the independent variables do explain significantly, the variation in attribute satisfaction.

Table 7.1 Test of H_{o1}

Attribute	R^2	F-test Sig. (p)	H_{o1}
Advance Booking Time	0.647	7.43E-18	Rejected
Arrival Time Info	0.319	1.63E-06	Rejected
Available When Needed	0.427	2.08E-12	Rejected
Booking Staff Attitude	0.359	1.29E-05	Rejected
Clean Vehicle	0.256	9.40E-05	Rejected
Comfortable Seats	0.126	1.04E-02	Rejected
Cost	0.213	3.69E-03	Rejected
Crowding	0.329	2.52E-07	Rejected
Driver Attitude	0.193	3.78E-03	Rejected
Ease Of Booking Service	0.502	8.47E-11	Rejected
Ease Of Entry/Exit	0.116	1.25E-02	Rejected
Ease Of Payment	0.148	7.56E-03	Rejected
Escort Attitude	0.217	8.45E-03	Rejected
Fatigue-Constant Attention	0.383	1.19E-07	Rejected
Invehicle Safety	0.137	1.11E-02	Rejected
Leg Room	0.126	1.19E-02	Rejected
Noise Level	0.338	6.83E-08	Rejected
Possible Destinations	0.406	4.91E-09	Rejected
Privacy	0.303	2.61E-06	Rejected
Routes Information	0.161	1.10E-02	Rejected
Seat Availability	0.302	2.07E-06	Rejected
Service Frequency Info	0.662	4.62E-23	Rejected
Smooth Ride	0.621	7.09E-24	Rejected
Storage Space	0.151	8.51E-03	Rejected
Temperature Control	0.263	4.30E-05	Rejected
Time	0.349	6.60E-07	Rejected
Travel Time Reliability	0.439	9.26E-11	Rejected
User Constraints	0.164	1.10E-02	Rejected
Vehicle To O/D Security	0.112	1.50E-02	Rejected
Vehicle-O/D Distance	0.175	3.92E-03	Rejected
Vehicular Transfers	0.369	2.16E-07	Rejected
Waiting Time Reliability	0.357	2.96E-07	Rejected
Weather Protection (Ln)	0.724	5.63E-33	Rejected
Wheel Chair Space	0.192	8.77E-03	Rejected

These results indicate that the use of the underlying factors for the established antecedents of satisfaction as identified in Figure 3.1 in predicting or explaining transport attribute satisfaction is justifiable. However, it is appreciated that the intricate interactions present at the antecedent level do have a considerable impact on satisfaction formation. This is because, while the variance explanation levels of the models developed here range from 11% to 72%, (mean = 31%), Khalifa and Liu (2002) were able to explain up to 84% of the variance in customer satisfaction with internet services by using the antecedents (PED) directly.

7.2.2 Hypothesis 2: $\rho_{m:u} = 0$

This hypothesis is set up to test the significance of the relationship between the model's output and the user's stated satisfaction value. It is tested by the significance of the Pearson Correlation coefficient ($\rho_{m:u}$) between the Transport-User Satisfaction Model output and the user-stated overall satisfaction values.

The correlation coefficient between them is 0.43, which for a degree of freedom, df = 162, is significant at a level of $p < 0.00$. Therefore the null hypothesis is rejected and the alternative hypothesis that there is a significant relationship between Sat_{TUSM} and Sat_{user} is accepted. Thus the Transport-User Satisfaction Model can be used to predict overall transport satisfaction. This is important, as the objective of this thesis is to develop a model capable of predicting overall transport satisfaction for transport users.

7.2.3 Hypothesis 3: $Sat_{TUSM} = Sat_{user}$.

The purpose of this hypothesis is to test the significance of any differences between output from the Transport User Satisfaction Model and the user's stated satisfaction value. The hypothesis is tested using the paired *t*-test for the significance of the mean difference, hypothesized to be zero, between $Satisfaction_{TUSM}$ and $Satisfaction_{user}$. The results of the *t*-test are as shown below in Table 7.2. The results indicate that there is some statistically significant difference between $Satisfaction_{TUSM}$ and $Satisfaction_{user}$. (Their means differ by 0.5058) Therefore, the null hypothesis is rejected and the alternative hypothesis accepted.

Table 7.2 T-test for H_{o3}

t-Test: Paired Two Sample for Means		
	TUSM Satisfaction	**User-stated Satisfaction**
Mean	6.049025	6.554878
Variance	0.597837	4.052185
Observations	164	164
Pearson Correlation	0.426	
Hypothesized Mean Difference	0	
df	163	
t Stat	-3.55321	
P(T<=t) one-tail	0.000249	
t Critical one-tail	1.654255	
P(T<=t) two-tail	0.000498	
t Critical two-tail	1.974622	

The rejection of the null hypothesis is not unexpected, as although a model attempts to represent a system, it makes no pretension at being the same as the system. However, it is also questionable whether the identified mean difference of 0.5058, on a 1 – 10 scale would have any practical significance. This will be investigated in the validation section that follows.

7.3 MODEL VALIDATION

Validation is about assessing the quality of a model. It involves testing the estimated model on an independent data set. This is necessary because models with apparent good fit to the data with which they were developed may show no fit to other data. Model validation is more of an estimation problem than a hypothesis-testing problem, thus the outcome is not binary e.g. pass/fail, but rather how good or how bad. Validation helps to characterize the confidence that could be placed in a model's output. Therefore the criteria for model validation must be relevant for the intended application of the model and the degree of precision required.

Generally model validation involves comparing the output of the model with the output of the system the model is representing. This is done to ascertain how well the model represents the system. Thus it is important to use output data not previously used in estimating or calibrating the model. This could be in the form of independent output data (for simulation models). For regression models, it could be data collected at another time and place or, where a large enough dataset has been collected in the survey, a portion of the dataset (a 'holdout' sample) could be kept aside to use in the validation process and the other portion used to fit the model.

The fitted model is used to estimate values for pairing with the holdout dataset. The measured values in the holdout dataset (or the independent data) are then regressed on these estimated values. This regression model is then checked for $\mathbf{R^2}$ and F-test significance or simply for the correlation $\mathbf{R_v}$ between the estimated values and the measured values. The correlation value $\mathbf{R_v}$ provides an unbiased estimate of the degree of transferability of the model being validated. Alternatively, the estimated values are compared with the measured values using a t-test to determine the significance or otherwise of their differences. In the Split-Sample cross-validation method, as a double check, the roles of the datasets could be switched such that each dataset is used to calibrate a model and the other used to validate the first and then vice-versa. The mean of the two validation correlation coefficients obtained is then used as the validation coefficient of correlation $\mathbf{R_v}$. This case is known as the double cross-validation and is rather restrictive, as it requires both datasets to be of the same size (Cooksey, 1996).

In surveys with small dataset size, it is not always possible to provide a holdout sample because of the requirement not to have a case:variable ratio lower than 10. So other methods are necessary. An easily accessed technique is the use of Rozeboom's $\mathbf{R^2}$. Rozeboom (1978) developed a crude estimate of the cross-validated $\mathbf{R_v}^2$, which could eliminate the need to double the required sample size. This statistic, the estimated or cross-validated $\mathbf{R^2}$ (or Rozeboom's $\mathbf{R^2}$) can be computed by the following formula:

$$\mathbf{R_R}^2 = 1 - (1 - \mathbf{R}^2)*\{(\mathbf{N} + \mathbf{k})/(\mathbf{N} - \mathbf{k})\}$$

Where

$\mathbf{R_R}^2$ = Rozeboom's $\mathbf{R^2}$.

N = the dataset size i.e. number of cases.

k = the number of predictor variables.

Rozeboom's $\mathbf{R}^2$ "answers the question,

> *'If I were to apply the sample regression weights to the population, or to another sample from the population, for what proportion of the Y variance would my thus-predicted Y values account*?'" (Cohen & Cohen, 1983, p.114).

This formula is quite useful for estimating $\mathbf{R}_v^2$ quickly. Other techniques for estimating cross-validated $\mathbf{R}_v^2$ involve resampling methods such as the k-fold cross-validation technique and the bootstrapping technique (Efron & Tibshirani, 1993). However, it must be acknowledged that some of these alternative techniques of validation trade off the advantage of not requiring a second dataset for validation against more computationally intensive statistical requirements.

7.3.1 Resampling Methods

The ***k***-fold cross-validation method involves dividing the data into k-subsets of approximately equal size. The model is estimated k-times, each time leaving out one of the sub-sets which is later used to predict the error for that estimated model (by comparing the values of the left-out subset and their corresponding values predicted by the estimated model). If ***k*** equals the sample size, N, then this process is equivalent to the leave-1-out cross-validation. The leave-1-out cross-validation works well for estimating generalized error for continuous error functions such as the mean squared error, but it may perform poorly for discontinuous error functions such as the number of misclassified cases. For discontinuous error functions, ***k***-fold cross-validation is better. A value of 10 for ***k*** is popular for estimating generalization error (Efron & Tibshirani, 1993).

The leave-1-out cross-validation, which is the most commonly used method, involves successive re-estimation of a model by withholding one observation from the computations. The estimated model is then used to predict the omitted observation and the residual recorded. Then the omitted observation is returned to the sample and the process is repeated sequentially for every observation in the dataset. The recorded residuals are then squared and summed to yield a measure of prediction error sum of squares (**PRESS**), which can be converted to an estimate of cross-validated $\mathbf{R^2}$ by this computation:

$$\mathbf{R_v^2 = 1 - (PRESS / (s_y^2)}$$

Where

$\mathbf{s_y^2}$ = standard deviation about mean of the dependent variable in the full sample.

The **PRESS** measure is also useful in selection between alternative regression models, with the best model being that with the smallest **PRESS** value (Cooksey, 1996). Picard & Cook (1984) reported the **PRESS** as an often-advocated method for use in assessing overall predictive ability of a fitted model.

The leave-1-out cross-validation method is often referred to as jackknifing in literature (e.g. NCHRP, 2003). However, some researchers (e.g. Mosteller & Tukey, 1977; Efron & Gong, 1983; Friedl & Stampfer, 2002) make a distinction between jackknifing and cross-validation: that even though they employ similar re-sampling methods, they are quite different technically. Whereas cross-validation is used to estimate generalization error, jackknifing is used to estimate the bias and variance of a statistic (for example, a goodness-of-fit statistic). Although the generalization error can also be estimated from an estimate of the bias of standard error, this process is more complicated than for cross-validation (Efron, 1982).

The bootstrapping technique involves estimating the regression model using random samples from the original dataset. Unlike cross-validation, where subsets of the data are repeatedly analysed, bootstrapping repeatedly analyses sub-samples of the data. The randomly sampled dataset, which must be of the same size N as the original data set, is obtained from the original dataset by allowing observation replacement such that any observation could potentially appear more than once in the bootstrap sample. For each model estimated, $\mathbf{R^2}$ is recorded and a distribution of $\mathbf{R^2}$ values is obtained based on which, the standard errors for the regression coefficients can be computed. This process is repeated 500 – 1000 times.

The mean bootstrap $\mathbf{R^2}$ value, $\mathbf{R_B}$, from this process estimates the cross-validated $\mathbf{R_v}$ and can be compared with the **R** from the original model to give an indication of the cross-validity of the model. If the bootstrapped standard errors are close in magnitude to the original standard error, then the evidence of validity for the original model is strong (Cooksey, 1996). The standard error for the mean $\mathbf{R_B}$ can also be computed empirically and compared to the value from the original model. Due to the large number of estimations, it is expected that the bootstrapping procedure would be a very good means of assessing prediction accuracy, but the intensity of its computational requirements is disadvantageous.

In comparing cross-validation and bootstrapping, Efron and Gong (1983) have said that cross-validation is essentially a Taylor series approximation to the bootstrap estimate and that the bootstrap is "only slightly better" than cross-validation in estimating the root mean squared error. However, cross-validation produces an unbiased estimate though sometimes with large variance, whereas bootstrapping produces estimates with less variance but with more bias (Efron and Tibshirani, 1997). Efron and Tibshirani (1997) further acknowledge that "leave-1-out cross-validation is reasonably unbiased, but *can* suffer from high variability in *some* problems" (emphasis added). Breiman and Spector (1992) have demonstrated that leave-1-out cross-validation has high variance if the prediction rule is unstable, but that 5-fold or 10-fold cross-validation would display a low variance.

The high variance of cross-validation has been identified mainly with discontinuous error functions such as that studied by Efron and Tibshirani (1997). For such discontinuous functions, $\boldsymbol{k}$-fold validation has been shown to be appropriate. Thus in comparison, it does appear that cross-validation is to be preferred to bootstrapping. Efron and Tibshirani (1997) acknowledge that cross-validation is the traditional method of preference and by their conclusion they appear to seek a compromise between the unbiased-ness of cross-validation and the reduced variance of their proposed bootstrap smoothing of the leave-1-out cross-validation.

7.3.2 Model and System Comparison

Once the two sets of comparative data from the model and system have been obtained, the comparison is usually based on classical hypothesis testing methods such as the *t*-test. Law and Kelton (1991) have questioned the appropriateness of this approach, holding that as a model is only an approximation to the actual system, a null hypothesis that the system and model are the "same" is clearly false. They suggest that it is more useful to ask whether or not the differences between the system and the model are significant enough to affect any conclusion derived from the model. Quite a number of other researchers also hold this view (See Ranstam (1996), Casella and Berger (1987), Hinkley (1987), Perry (1986), LaForge (1967), Rozeboom (1960), etc.). Graybill (1976) goes as far as saying:

> "*when making inferences about parameters ... hypothesis tests should seldom be used if confidence intervals are available ... the confidence intervals could lead to opposite practical conclusions when a test suggests rejection of H_0 ... even though H_0 is not rejected, the confidence interval gives more information*".

Thus they suggest, in preference to standard hypothesis testing, it would be better to construct confidence intervals for the difference between the model output and the system output. A confidence interval provides more information than the corresponding hypothesis test, providing both the outcome of the hypothesis test and an indication of the magnitude by which both outputs differ. Confidence intervals incorporate the classical statistical testing as well as additional information and are a more meaningful way of assessing model precision. Therefore, it seems appropriate to consider the confidence interval approach as a more suitable way of validating a decision model such as the one developed in this thesis.

The confidence interval approach involves setting the level of confidence (**CL**) required for the model output and, based on this confidence level, determining the significance level, $\boldsymbol{\alpha}$ ($\boldsymbol{\alpha} = \mathbf{1 - 0.01*CL}$) at which to apply a paired t-test. The confidence interval (**CI**) is set with upper and lower endpoints, $\mathbf{U(\alpha)}$ and $\mathbf{L(\alpha)}$ respectively and is calculated from the following formula:

$$CI = (\bar{E}) \pm t_{(N-1),(1-\alpha)} * [\sqrt{Var(\bar{E})}]$$
$$(\bar{E}) = \bar{U}_s - \bar{U}_m$$
$$Var(\bar{E}) = \{ \sum(E_i - \bar{E})^2 \} / \{N*(N-1)\}$$

Where,

$\bar{U}_s$ = average system output

$\bar{U}_m$ = average model output.

E_i = difference between system output and model output for case i.

N = number of cases.

If the confidence interval (**CI**) does not include 0, then the difference E_i is said to be statistically significant at level α. But if **CI** does include 0, then E_i is not statistically significant at level α and any observed difference may be explained as sampling fluctuation.

However, it must be noted that having statistically significant differences does not for practical purposes mean that the model is an invalid representation of the system. Johnson and Tsui (1998, p.378) state,

> "*Statistical significance is different from practical significance. In some situations, confidence intervals help us assess the practical significance of departures from a null hypothesis.*"

Matloff (1991) similarly states, "*statistical significance is not the same as scientific significance*". Chew (1980) states,

> "*... means are significantly different ... This is a very unfortunate choice of terminology, because the significant difference in the statistical sense is often taken, incorrectly, as being significant in the practical or economic sense.*"

Law and Kelton (1991, p.320) also state,

> "*the difference between a model and a system is **practically significant** if the 'magnitude' of the difference is large enough to invalidate any inferences about the system that would be derived from the model*".

Thus, it would be a profitable exercise to consider how the model output could vary within the confidence interval computed and the effect on the decisions made as the values vary.

The determination of practical significance can be subjective, and is dependent on the purpose of the model (i.e. the objective of its use). It seems that a possibly objective approach to the determination of practical significance could involve computing the ratio of the difference ($\mathbf{E_i}$) to the value of the system output. For example, the practical significance of $\bar{\mathbf{E}}$ being 1, would be different for the case where $\bar{\mathbf{U}}_s = 1000$ and $\bar{\mathbf{U}}_m = 999$, than for the case where $\bar{\mathbf{U}}_s = 10$ and $\bar{\mathbf{U}}_m = 9$.

There is a need for additional measures of performance by which practical significance can be assessed. Jessop (1990) listed commonly used alternative indicators of performance that are designed to indicate in a general way how good a forecasting model is. The measures were all mean errors where the means were measured differently. The list was as follows:

1. The mean absolute error, MAE = $\{\Sigma|X_i - F_i|\}/N$, where the error is measured by the absolute value of the difference between actual (X) and forecast (F) values. MAE treats all differences equally.

2. The mean absolute percentage error, MAPE = $\{100*[\Sigma|X_i - F_i|/X_i]\}/N$, where the error is measured by the absolute difference between actual (X) and forecast (F) values expressed as a percentage. MAPE gives equal weights to equal percentage differences. However, care in interpretation is needed here, because large values of percentage differences may arise both due to large absolute differences and also small actual values.

3. The mean square error, MSE = $\{\Sigma(X_i - F_i)^2\}/N$, where the error is measured by the square of the difference between actual (X) and forecast (F) values. MSE gives extra importance to large differences. But MSE has units that are the square of the original data and this can lead to difficulty in interpretation. So its square root is sometimes taken to give the root mean square error (RMSE).

McClave & Dietrich (1991) have suggested that the interval ±2*RMSE provides a rough approximation to the accuracy with which a model would make predictions. Essentially, this measure indicates that the model would predict a value that is within ±2*RMSE of the actual value. As accuracy improves, the interval ±2*RMSE would narrow. While measures such as these would give a rough estimation of the predictive accuracy of a model, as model performance measures, they do not really provide information as to how far or close, within the prediction interval, the model output is with respect to the system output.

For consistency in use and objective assessment of a model, performance measures that compare the model's output with that of the system in relation to the objective of the model's use and the confidence level required for such use are necessary. The development of such measures will be discussed in the next section.

7.4 MODEL PERFORMANCE MEASURES

To obtain an adequate assessment of the performance of the overall transport satisfaction model, acceptable boundaries of satisfaction would need to be set, within which the assessments of transport vehicle options can be deemed to be close enough to those of the user. In other words, satisfaction threshold levels could be set such that satisfaction levels within thresholds are similar enough for the user to be indifferent between them. Law and Kelton (1991) suggest that if a model is 'valid', then the output of the model should be similar (i.e. not necessarily identical) to that of the system. However, they do not proceed to specify what is meant by the term "similar to". Ortuzar & Willumsen (2001, p.181) state:

> *"A general strategy for validating a model would be to check whether it can reproduce a known state of the system with sufficient accuracy."*

Again, they do not suggest an objective indication of what they mean by sufficient accuracy.

There is, therefore, a need to develop a similarity measure by which an estimate can be made of the degree to which both (model and system) outputs are similar. In addition to a similarity measure, a measure of the model's performance with specific reference to the objective of its use is also necessary.

7.4.1 Similarity Measure

An adequate similarity measure would depend on the definition of similarity. Tyler (1992) took this approach in the assessment of the performance of the model he developed. While the principle of a similarity measure can be considered to be generic, the specific formulation would depend on the particular case in consideration.

Using inter-quartile levels as thresholds, similarity could be defined as follows. Two transport vehicles are deemed to be similar in terms of satisfaction provision if they both fall within the range of a quartile. For a satisfaction scale of 1 – 10, threshold levels would be set as:

Level 1: Satisfaction $<= 0.25$
Level 2: $0.25 <$ Satisfaction $<=5.0$
Level 3: $0.5 <$ Satisfaction $<= 7.5$
Level 4: Satisfaction $>= 7.5$

The problem with this approach is that transport services with threshold boundary values would be subject to bias. Values near the lower boundary of a level would have a bias towards them in that they would be considered better than the top of their lower neighbouring threshold only one point (or less) lower in value, and yet be as good as the top of their own threshold 2.5 points away.

A less biased approach would be one in which a band is established around a satisfaction score S_i such that any other score within that band is considered to be similar enough to S_i for the client to be indifferent between them. If the model performance criterion is set as a maximum 10% variation about the user score on a 10-point scale, this would imply a band width of 2 (i.e. ± 1) about the measured score.

A similarity measure SM can then be derived as follows:

Let $D_i = |\, \mathbf{Sat}_{Mi} - \mathbf{Sat}_{Ui} \,|$

Where D_i is the modulus of the difference between $\mathbf{Sat}_{Mi}$ and $\mathbf{Sat}_{Ui}$.

$\mathbf{Sat}_{Mi}$ is the satisfaction value predicted by the model for user i

$\mathbf{Sat}_{Ui}$ is the measured satisfaction value for user i.

Then,

$$SM = 1 - (\Sigma D_i)/(Z*N)$$

D_i indicates the extent to which the satisfaction model output approximates the i^{th} user's stated value. ΣD_i is the summation of D_i over the dataset being used for the validation exercise. Z indicates the size of the scale on which the satisfaction scores have been measured. In this study, Z is 10. N is the number of cases in the dataset. Therefore,

$$SM = 1 - (\Sigma D_i)/(10N).$$

The similarity measure SM would take a value within the range: zero to one, and the value would be a measure of the similarity between the model output and the users' stated values with similarity increasing as SM approaches one.

7.4.2 Performance Measure

In the context of this thesis, where the objective is to allocate satisfactory transport vehicles to meet requests from clients, there is a systematic difference in the importance of the possible error types. Two types of error are possible: predicting a lower satisfaction level transport to be at a higher level of satisfaction (overestimation), and predicting a higher satisfaction level transport to be at a lower level (underestimation). The implication of the first error (overestimation) is that a client would be offered an unsatisfactory transport and the effects of dissatisfaction – diminished loyalty and possibility of non-reuse – could be expected. The implication of the second error would be that there could be fewer options available than is really the case. Thus overestimation presents an error with worse impacts than would be generated by underestimation. To check the ability of the decision model to perform consistently and well, it is therefore necessary to derive a performance measure that takes these issues into account.

The measure of performance ***PM*** would be based on the error rate ***ER*** of the model, where the error rate of the model would be the percentage erroneous prediction of lower satisfaction transport as higher satisfaction transport.

ER = 100*(Number of overestimated cases)/(Total number of cases, N)

PM = 100 – ER.

The use of the error rate as the basis of the performance measure of the model also has the advantage of providing a confidence level at which the model can be used. For instance a PM of 70% would suggest a 70% confidence that the user is being provided with transport at least as satisfactory as his or her preferred threshold.

7.5 VALIDATION OF SATISFACTION MODELS

7.5.1 Introduction

In this thesis, 34 travel-attribute satisfaction models were estimated and used as inputs for the overall transport satisfaction model (TUSM).

The models to be validated are the satisfaction models developed for each of the 34 travel attributes and the overall transport satisfaction model. The overall transport satisfaction model (TUSM) was developed as a simulation-type model representing a user's satisfaction formation process. The attribute satisfaction sub-models, which constitute the inputs to the overall transport satisfaction simulation model, were estimated on the basis of OLS multiple regression using data collected as described in Chapter 5. It is acknowledged that in this thesis, the output of interest is that from the overall transport satisfaction model (TUSM). However, in order to assess the internal consistency of the TUSM model, it is proper that the validity of its constituent sub-models be assessed even if only at a crude level. Doing this would, in addition, provide a basis for their possible use to predict satisfaction for an individual travel attribute.

To validate these models, it is necessary to consider the issue of the validation data. For the overall transport satisfaction model (TUSM), there exists an independent paired data set for validation, i.e. the overall satisfaction score provided by the survey respondents, which has not been used in the estimation of the overall transport satisfaction model or its input sub-models. However, for the attribute satisfaction models, such an independent dataset is not available. Even though the sizes of dataset (N ranged from 111 – 154) used for estimating these models provided case:variable ratios greater than the minimum ratio of 10 (meaning that it would have been possible to keep some data aside as the validation sample) it was decided not to split the data. This was because it was felt that the larger the dataset used in model estimation, the greater the potentials of the model being a good representation of the system. So, for the attribute satisfaction models it is necessary to use one of the validation methods reviewed in Section 7.3 above.

Cross-validation would be appropriate for use in the validation of the transport attribute satisfaction models. Using this technique, however, would require just under 5,000 regression model estimations and the attendant error computations as there are 34 attribute satisfaction models with an average dataset size of N = 140. In the context of this thesis, it is considered sufficient to apply the Rozeboom's estimate ($\mathbf{R_R}^2$) of the cross-validated $\mathbf{R_v}^2$ as the means of assessing their out-of-sample validity. Thus to validate the transport attribute satisfaction sub-models, Rozeboom's estimate ($\mathbf{R_R}^2$) of the cross-validated $\mathbf{R_v}^2$ will be computed for each of them and the significance of the corresponding $\mathbf{R_R}$ taken as evidence of the validity of the sub-model.

In the following sections, the results from the validation of the overall transport satisfaction model and the attribute satisfaction models will be presented and the implications and deductions from these results will be discussed.

7.5.2 Attribute Satisfaction Models

To validate the attribute satisfaction regression models, Rozeboom's ($\mathbf{R_R}^2$) estimate of the cross-validated $\mathbf{R_v}^2$ was computed for each model. The significance of this statistic for each model was determined by computing the counterpart correlation coefficient $\mathbf{R_v}$ and checking against statistical tables of critical R-values at the appropriate p-level. The results are as shown in Table 7.3 below.

As shown in the table, all the customer satisfaction regression models for the transport attributes are statistically valid. Thus, it can be said that the Transport User Satisfaction Model is internally consistent. The validity of these transport attribute satisfaction models further provides some degree of confidence in their potential use as predictive models for user satisfaction for each attribute. At the very least, the functional forms for these models would be generalizable as the following researchers have suggested: (Lerman and Louviere, 1978; Meyer et al, 1978; Ortuzar and Willumsen, 1994, p.252; and Ortuzar and Willumsen, 2001, p.280)

Table 7.3 Validation Results for Attribute Satisfaction Models

Attribute	R^2	R_v	Critical R ($p<0.05$)	Valid Model
Advance Booking Time	0.558	0.747	0.182	Yes
Arrival Time Info	0.182	0.426	0.164	Yes
Available When Needed	0.330	0.574	0.158	Yes
Booking Staff Attitude	0.190	0.436	0.185	Yes
Clean Vehicle	0.107	0.327	0.158	Yes
Comfortable Seats	0.030	0.175	0.158	Yes
Cost	0.043	0.208	0.163	Yes
Crowding	0.195	0.442	0.157	Yes
Driver Attitude	0.039	0.199	0.160	Yes
Ease Of Booking Service	0.376	0.613	0.182	Yes
Ease Of Entry/Exit	0.029	0.173	0.160	Yes
Ease Of Payment	0.036	0.191	0.161	Yes
Escort Attitude	0.044	0.210	0.186	Yes
Fatigue-Constant Attention	0.243	0.493	0.173	Yes
Invehicle Safety	0.032	0.180	0.165	Yes
Leg Room	0.028	0.169	0.159	Yes
Noise Level	0.213	0.462	0.159	Yes
Possible Destinations	0.278	0.527	0.169	Yes
Privacy	0.168	0.410	0.161	Yes
Routes Information	0.029	0.171	0.167	Yes
Seat Availability	0.169	0.411	0.160	Yes
Service Frequency Info	0.590	0.768	0.168	Yes
Smooth Ride	0.551	0.742	0.157	Yes
Storage Space	0.031	0.176	0.159	Yes
Temperature Control	0.123	0.350	0.160	Yes
Time	0.208	0.456	0.170	Yes
Travel Time Reliability	0.321	0.567	0.167	Yes
User Constraints	0.035	0.188	0.175	Yes
Vehicle To O/D Security	0.031	0.176	0.167	Yes
Vehicle-O/D Distance	0.049	0.222	0.164	Yes
Vehicular Transfers	0.235	0.485	0.175	Yes
Waiting Time Reliability	0.219	0.468	0.169	Yes
Weather Protection (Ln)	0.673	0.820	0.158	Yes
Wheel Chair Space	0.031	0.178	0.170	Yes

7.5.3 Overall Transport Satisfaction Model (TUSM)

As stated in Section 7.5.1 above, there exists independent data for the validation of this model. The traditional validation process is essentially the same as the test for the hypothesis H_{o3} presented in Section 7.2.4. There the results of the t-test indicated a statistically significant difference between $\text{Satisfaction}_{\text{TUSM}}$ and $\text{Satisfaction}_{\text{user}}$ at the $p<0.05$ level. (Their means differed by 0.5058). In addition, the 95% confidence interval for this difference was computed and obtained as 0.225 – 0.787. As expected for a statistically significant mean difference, the confidence interval does not include zero. This suggests that TUSM is not a statistically significant model (at least at the $p=0.05$ level). However, as discussed in Section 7.3.2, this does not mean that TUSM is practically insignificant or invalid.

Thus, considering the argument of Law and Kelton (1991) in Section 7.4 above, the similarity (**SM**) and performance (**PM**) measures (as defined in Section 7.4) have been computed for the overall transport satisfaction model (TUSM). A value of 0.846 was computed for the Similarity Measure (**SM**), while the Performance Measure (**PM**) was computed and a value of 86.0% was obtained. The **SM** value suggests good similarity between the satisfaction value predicted by the Transport-User Satisfaction Model and the satisfaction values stated by the users modelled. The **PM** value suggests that a user of the model can be 86% confident that the customer's satisfaction preference is being met. The incidence of the performance measure being higher than the similarity measure could be related to the tendency of the model to underestimate rather than overestimate as seen from the positive mean difference above.

7.5.4 Discussion

The positive mean difference value between the system (user) and the model, suggests that the TUSM tends to underestimate the user satisfaction value. Though not ideal, this tendency is not disadvantageous to the objective of the model. Looking at the mean difference value and the 95% confidence limits of its value (i.e. 0.225 and

0.787), it is questionable whether or not the model and the system (i.e. the user) are different in a sense that is "practically significant" (Law and Kelton, 1991).

As suggested by Johnson and Tsui (1998), a critical consideration of the confidence interval values would help in determining practical significance or otherwise. Such a consideration here indicates that neither the upper nor the lower level of the confidence interval would cause the model mean output to suggest a different inference than the system's mean output. For example, for a system mean satisfaction value of 7, the model, operating with a mean difference of 0.5058 (confidence interval: 0.225 – 0.787), would output a value within the range 6.224 – 6.786. For practical purposes, this range is not considered wide enough to cause conflicting decisions. Thus TUSM can be said to be practically valid.

However, since the TUSM is a case-by-case model, using the mean value to assess it may not achieve much. There is a need to look at the difference between the model and the system for each case. Thus the Similarity and Performance Measures were computed and each of these indicators suggests that the TUSM model performs with reasonable accuracy. The reasonable performance of this model despite its statistically significant difference from the system brings to question, the relevance of classical statistical hypothesis testing to decision model validation.

Considering a hypothetical situation, where a revised TUSM model is expressed as C + $\Sigma(W_i{*}AS_i)/\ \Sigma W_i$ and C is made equal to 0.5058 (the known mean difference between system and model), such that the revised TUSM Model (***TUSM****) would not be statistically different from the system, would such a model perform significantly better than the derived TUSM model? The comparative values are shown in Table 7.4 below.

Table 7.4 Model Comparison

MEASURE	TUSM	*TUSM**
Similarity Measure	0.846	0.856
Performance Measure	86%	83%

Comparing these values, there is not much improvement on TUSM by *TUSM** in terms of the Similarity Measure and *TUSM** even performs worse in terms of the Performance Measure, suggesting that *TUSM** over-predicts more often than TUSM. This is crucial as over-prediction is the critical error in this decision process. Thus it does appear that statistical significance or insignificance may not be the best predictors of model validity or invalidity, at least in practical application. Rosnow and Rosenthal (1989) have said,

> "*A result that is statistically significant is not necessarily practically significant as judged by the magnitude of the effect*".

Perhaps there is a case for the development of more appropriate measures of model validity.

Classical hypothesis testing for significance of difference is based on the premise that a distribution can be represented by its mean and variance; and any two distributions can be deemed to be from the same population (and hence the same) if their means and variances are similar in value. The suitability of this premise to decision models is debatable. Law and Kelton (1991) have suggested that classical statistical hypothesis tests are irrelevant to decision model validation. Several other researchers have queried the universality of classical statistical hypothesis tests in model assessment. See Johnson (1998) for a listing of such references and also Morrison and Henkel (1970) for a sound discourse on the debate.

7.6 CONCLUSION

In this chapter, an attempt has been made to test the hypotheses proposed in Chapter 3 and also to validate the Transport-User Satisfaction Model developed in Chapter 6. The hypotheses tests show that the independent variables explain significantly the variation in transport attribute satisfaction and that TUSM can predict user overall transport satisfaction. The tests also show that TUSM is not exactly the same as the user – which is not unexpected as a model although representing a system, makes no claim to being the system.

The model validation exercise shows that TUSM has internal consistency (in terms of reliability) as the sub-models within it (the attribute satisfaction regression models) were found to be statistically valid. This also presents the potential for the possible use of these models in predicting travel attribute satisfaction. The model validation exercise also shows TUSM performing very well (> 80%) in terms of similarity and performance measures. In terms of avoiding the critical error of this decision process, TUSM performs better than a hypothetical statistically valid model. This finding adds weight to the current querying of the suitability of classical statistical hypothesis tests to decision model validation exercises.

In the next chapter, the results of this thesis and their implications will be discussed in relation to existing customer satisfaction formation models.

CHAPTER 8

DISCUSSION

8.1 INTRODUCTION

The previous three chapters presented the data collection and analysis, and the results of the model estimations, the form of the overall transport satisfaction model and the outcomes of the hypotheses tests and the validation exercise. This chapter will discuss the implications of these results and outcomes.

The results of the data analysis support the proposition that a valid overall transport satisfaction prediction model can be developed. The developed model involves two stages: the computation of the satisfaction due to each user-relevant travel attribute and the combination of these attribute satisfactions into the overall transport satisfaction value for that user. Therefore, the results and their implications will be discussed in two sections – one for each stage of the model. The implications of these results for the customer satisfaction field in general and the transport satisfaction field in particular will also be addressed.

8.2 RESULTS

8.2.1 Attribute Satisfaction Models

The attributes, for which satisfaction models were estimated, were selected based on the comprehensive review of the literature on travel attributes presented in Chapter 4. A discussion on some findings from that review was also presented in Chapter 4. An observation worth noting here was the prevalence of multiple attribute nomenclature or descriptors for similar characteristics of a transport service. This would suggest that detailed investigations of the exact understanding and perception of travel attributes to transport users may be essential for proper identification of appropriate nomenclature for travel attributes to elicit the 'true' response from users when they have to rate or access travel attributes.

Another observation from the attribute survey data worth mentioning here was that, among the ratings respondents provided for both importance and satisfaction with respect to the attributes, there were fractional values such as 6.5 and 5.5. This confirms the assertion made in Section 4.3.2, that given an end-anchored scale on which to make ratings, respondents would treat the scale as continuous and interval in nature and not as ordinal. Thus the insistence on the use of ordered probit modelling techniques for data involving ratings should take consideration of how the scale for rating is described, i.e. whether it is an ordered list of categories or whether it is an end-anchored number scale.

In attempts to reduce the large numbers of transport attributes to a manageable number of factors, factor analysis is often employed to group the attributes. Such grouping is often based on attributes correlating strongly. From this study, it would appear that such an approach would be defective. This is because in grouping attributes, the fine distinctions that transport users make between the attributes in terms of both importance and satisfaction are lost. For instance, a study of Table 5.2 shows that fewer respondents indicated the attribute dimensions (e.g. COMFORT, CONVENIENCE, etc) to be relevant, compared to the number that considered their constituent attributes to be relevant. Thus more respondents are able to identify with the substantive elements of an attribute than with its dimensions. It is also evident that the importance rating for attributes within a dimension group ranged widely. Thus if these attributes had all been represented by a single dimension, what importance value would have been assigned to it? Perhaps, the average of the importance values would be used, but then the fine distinctions would be lost. TRB (1999a) also cautioned against the reduction of individual factors to 'umbrella' dimensions, having found that different respondents, given the opportunity, place the same factors into different dimension groups.

The results for the attribute satisfaction regression models show different variables achieving significance for different attributes. This indicates that the satisfaction formation processes for travel attributes do not all follow the same model. This suggests that transport satisfaction is a multidimensional phenomenon and that different response characteristics exist for its dimensions. Oliver (1997) had suggested that for multi-attribute goods and services, different attributes could have different satisfaction response characteristics. The implication of this is that in transport satisfaction studies, efforts should be taken to identify and treat each attribute uniquely. It should not be assumed that transport satisfaction as a whole would have a unique response characteristic. Therefore, in measuring and modelling transport satisfaction, provision should be made for measuring and modelling its component attributes.

In the following section, the satisfaction formation patterns for the travel attributes will be discussed. Table 8.1 below summarises for the travel attributes, the variables that attain statistical significance.

Table 8.1 Attribute Satisfaction Models: Significant Variables

Attribute	LOS	Importance	Age	Gender	Disabled	Occupation	PastTranspExp	LOS&Imp term	Imp&Age term
Weather Protection (Ln)	✓					✓			
Clean Vehicle	✓								
Temperature Control									
Fatigue-Constant Attention		✓					✓		
Privacy							✓		
Comfortable Seats							✓		
Smooth Ride	✓			✓			✓		
Leg Room					✓	✓	✓		
Noise Level	✓								
Crowding	✓	✓							
Seat Availability	✓								
Available when needed	✓								✓
Vehicular transfers	✓								
Wheel Chair Space	✓						✓	✓	
Ease of Entry/Exit			✓				✓		
Storage space							✓		
Ease of payment		✓							
Ease of booking service	✓	✓					✓		
Vehicle-O/D distance									
User Constraints	✓					✓			
Possible destinations	✓	✓				✓			
Advance booking Time		✓			✓		✓		
COST	✓		✓				✓		
Driver Attitude		✓				✓			
Escort Attitude		✓				✓			
Booking Staff Attitude		✓				✓			
Routes Information		✓					✓		
Service frequency Info		✓	✓			✓	✓		
Arrival time Info						✓	✓		
Waiting Time Reliability									

Attribute	LOS	Importance	Age	Gender	Disabled	Occupation	PastTranspExp	LOS&Imp term	Imp&Age term
Travel Time Reliability									
Invehicle Safety	✓	✓						✓	
Vehicle to O/D Security	✓								
TIME						✓			

Notes:

1. Occupation variables included Student, Worker, Jobseeker and Retired.
2. Past Transport Experience variables included Public Transport, Private Car, Cab and Community Transport/Dial-a-Ride.

From Table 8.1, it can be observed that:

1. The attributes do not all have the same variables attaining statistical significance in their satisfaction model. Performance is significant for some, but not for others. The same observation holds for the other key variables: attribute importance and users' past transport experiences. This suggests that satisfactions with the different attributes are oriented on different variables. This has implications for service improvements and customer satisfaction enhancement, and thus it will be discussed further below.
2. Occupation variables attain statistical significance in quite a number of attributes. This has not been observed before in customer satisfaction studies for other goods/services. It seems to suggest that transport service is unique amongst other goods and services in that it is influenced by a socio-demographic characteristic of the user as well as the expected characteristics of service performance, user preferences and experiences. Perhaps this is because transport is essential to movement and being in certain occupations requires movement.
3. Some attributes had several of these key variables simultaneously attaining statistical significance. While this indicates that these variables each directly influence satisfaction, this study cannot clearly say that these simultaneously significantly-occurring variables are interacting in the manner that Oliver's EDP model describes as Disconfirmation (Oliver, 1997). An exception may have to be made in the two cases where the interaction term of performance and importance (LOS*Imp) was significant.
4. Satisfaction with the crew behaviour attributes (Booking Staff, Driver, and Escort) were all influenced by strength of preference and user occupation. This is not surprising as essentially, what is being assessed here is the user's satisfaction with the helpfulness of the transport staff whether it be the driver, the booking staff or the escort. However, considering that different transport modes would differ in which of these staff users encounter, the provision of separate attributes for the different possible staff is necessary.

Performance-oriented attributes are here defined as attributes for which the performance variable attains statistical significance in the satisfaction model. Such attributes in this study include Available when needed, Clean Vehicle, Cost, Crowding, Ease of booking service, In-Vehicle Safety, Noise Level, Possible Destinations, Seat Availability, Smooth Ride, User Constraints, Vehicle to O/D Security, Vehicular transfers, Weather Protection (Ln) and Wheel Chair Space. For these attributes, performance level directly influences satisfaction and so improving performance levels should influence increase in satisfaction levels. Thus for these attributes, efforts should be made to provide the highest level of service possible.

Preference-oriented attributes are here defined as attributes for which the attribute importance variable attains statistical significance in the satisfaction model. Such attributes in this study include Advance booking Time, Booking Staff Attitude, Crowding, Driver Attitude, Ease of booking service, Ease of payment, Escort Attitude, Fatigue-Constant Attention, In-Vehicle Safety, Possible destinations, Routes Information and Service Frequency Information. For these attributes, users' strength of preference for the attributes directly influences satisfaction. To increase satisfaction levels for such attributes, in addition to improving performance levels, efforts should be made to provide as diversified as possible services to meet the varied preferences of users. Further, strategies can also be put in place to influence user's preferences. For instance, marketing techniques exist by which consumers can be influenced to desire new products and services or new features in existing products and services.

Experience-oriented attributes are here defined as attributes for which past transport experience variables attain statistical significance in the satisfaction model. Such attributes in this study include Advance Booking Time, Arrival Time Information, Comfortable Seats, Cost, Ease of booking service, Ease of Entry/Exit, Fatigue-Constant Attention, Leg Room, Privacy, Routes Information, Service Frequency Information, Smooth Ride, Storage space and Wheel Chair Space. For these attributes, users' past transport experiences directly influence satisfaction. This suggests that there is an on-going comparison exercise by which the user assesses the current performance against the standard of his or her previous experiences. To maintain and increase satisfaction levels for such attributes, providers need to keep abreast of innovations and improvements in the transport industry. In addition, efforts should be made to improve service levels, but with a longer-term expectation of response from the users. This is because of the time lag between their first experience of the improvement and their response, and the effect on their future choices. For these attributes also, intense advertising could create, via information, specifically desired expectations in the users.

Brog (1998) presents an innovative marketing technique called 'Individualized Marketing' which was successfully demonstrated in Germany. This technique is based on the premise that public transport usage is hindered by negative subjective perceptions, and a lack of experience and motivation to use it. Thus the objective of the technique is to change perceptions and also to present opportunity for experience of the service. Therefore in addition to improving a service, it is necessary to motivate people to use it so that they can experience the improvement and hopefully like it. A full description of the technique is presented in the paper (Brog, 1998).

Occupation-oriented attributes are here defined as attributes for which occupation variables attain statistical significance in the satisfaction model. Such attributes in this study include Arrival Time Information; Booking Staff Attitude; Driver Attitude; Escort Attitude; Leg Room; Possible destinations; Service Frequency Information; Time; User Constraints and Weather Protection (Ln.). For these attributes, occupation directly influences satisfaction and thus it may be worthwhile studying what characteristics of different occupations create expectations of the transport service and what expectations they create, so that appropriate steps could be taken to provide for those expectations and thus influence increases in satisfaction levels. Perhaps such characteristics would include time of day for travel, need for rapid movement from site to site, need to arrive at destination in a calm and presentable state of mind and of body, and need for time-strict movement plans.

The observations from the second stage of the TUSM modelling process will be discussed in the following sections.

8.2.2 Overall Transport Satisfaction Model

The overall transport satisfaction process has been shown to be well modelled by a weighted averaging function of the user's satisfaction for the relevant travel attributes. The occurrence within the TUSM of attribute satisfaction sub-models with widely differing satisfaction formation processes does not permit comments on the possibility of an overall transport satisfaction formation process. It should suffice to say that transport is a multi- and heterogeneously processed - attribute system and should be treated as such rather than as a homogenous system.

The observation that a weighted averaging function fits better than a summation linear additive function suggests that transport attribute satisfaction levels are complementary and users perform mental trade-offs moderated by the strength of their preferences (i.e. the importance values) for the attributes.

Thus, the Transport-User Satisfaction Model (TUSM) takes the form of an importance-weighted linear combination of the user-relevant attribute satisfaction levels. This model was found to be statistically different from the user but as already discussed in Chapter 7; this was not unexpected, as a model is only a representation, at some level of abstraction, of the system (in this case a transport user). However, the mean difference found between the model and the system, although statistically significant (at $p<0.05$), was physically so small (5%) in comparison to the scale of satisfaction values being predicted, that the question of the practical significance of this difference had to be addressed.

For decision or decision-support models, the practical significance of the difference between the model and the system is assessed in terms of its effect with respect to the decision task (see Law and Kelton, 1991 and Johnson and Tsui, 1998). Thus Similarity and Performance Measures were defined and computed for the TUSM. The Similarity Measure assessed the closeness of the model's output to the user's stated satisfaction value relative to the scale of rating. For this measure, TUSM achieved 0.85. The Performance Measure assessed the performance of the model with respect to the critical error of this decision task, which is the error of over-prediction (i.e. predicting a satisfaction value that is higher than the user's rating).

TUSM only over-predicted in 14% of the cases, thus achieving a score of 86% on the Performance Measure. Thus on both similarity and critical error avoidance measures, TUSM has performed reasonably well (attaining scores of 85% and higher).

In comparison to a hypothetical, 'statistically' valid model (i.e. a model not statistically significantly different from the user), the Similarity Measures for both models were about the same (0.85 vs. 0.86). However, for the Performance Measure, TUSM scored higher than the hypothetical, 'statistically' valid model (86% vs. 83%). Thus even though TUSM is considered not to be statistically valid, it is seen to perform better than a hypothetical statistically valid model on the critical error avoidance measure. It also performs as well as the hypothetical statistically valid model on the similarity measure. This finding seems to suggest, at least for decision models, that statistical significance or insignificance may not be appropriate predictors of model performance. Thus, there may be a need to investigate the development of appropriate validity-assessment techniques for decision models.

The development and validation of the TUSM does provide encouraging support for the potential of the use of satisfaction prediction models in transport provision and in transport planning. As it has been shown that it is possible to predict transport-user satisfaction given some easily accessible information on the user and the transport service, the use of such models would enhance quality transport provision and more user-sensitive transport planning. The objective of this thesis has, thus, been met: a tool that can help transport brokers in systematically considering user preferences and satisfaction requirements in transport provision decisions has been developed.

This study presented a case for the need to include, systematically, customer satisfaction criteria in transport provision with a view to increasing the use of transport. TRB (1998) similarly considers that transit ridership can be increased through a strong rider retention effort based on an effective programme of market and customer research. They encourage transit organizations to be more customer-oriented and to put the customer's interest first in service provision. A tool such as the TUSM would help transport organizations do just this. In TRB (1999a, pp. A-72), recognition is given to *'an emerging wave of transit marketing applications that adopt a consumer-based approach to transit service operations'*.

The implication of these results for an emerging transport satisfaction modelling technique and the existing consumer satisfaction models will now be discussed.

8.2.3 Transport Satisfaction Theory

From an overview of the satisfaction formation mechanisms for all the travel attributes, it appears that for attributes that have better defined measurement points, satisfaction is influenced by performance variables more than by past experience variables. While for less objectively measured attributes like booking staff attitude and comfortable seats, prior experience and hence expectations influence satisfaction more than performance. This is in line with findings in consumer satisfaction literature (Churchill and Surprenant, 1982) that goods/services with clearly defined and measurable dimensions or attributes tend to be more influenced by performance in satisfaction formation than other types of goods.

The finding that for different attributes, satisfaction is formed by different mechanisms highlights the shortcoming of evaluating transport satisfaction via performance indicators alone. It also confirms the literature that within the expectation-disconfirmation-performance framework, any or all of these antecedents of satisfaction could be active in satisfaction formation. This confirms the relevance of incorporating all of users' expectations and/or past experience and preferences in evaluating satisfaction.

Considering the tendency for studies to investigate consumer's satisfaction with different products, services and concepts rather than investigating the person-type satisfaction formation processes, as Oliver and DeSarbo (1988) tried to do, it could be suggested that the distinctions between satisfaction formation processes is more dependent on product/service/concept differences than on people differences.

However, while it cannot be said that a person forms satisfaction for different products/services in the same way, the converse has not been proven either.

The R^2 values obtained for the transport attribute satisfaction regression models (0.11 – 0.72; mean = 0.31), has such a wide range, that it can only be said that the attributes do really differ in the response pattern they stimulate. Considering that similar models have not been developed in transport, it is difficult to compare these values. However, on the general basis of consumer satisfaction models, it does appear values in the higher range are more to be expected than values in the lower range. For example, Khalifa and Liu (2002) were able to explain over 80% of the variance in customer satisfaction with internet-based services by combining expectations disconfirmation, desire disconfirmation, and perceived performance in a model.

In the development of TUSM, these satisfaction antecedents were not used; rather the factors that influence them were used (i.e. characteristics of the transport service and of the user). Thus it does appear that the contribution to satisfaction formation of the disconfirmation process, which has not been explicitly represented in the models in this thesis, could be vital. To increase the amount of variance explained by these models, therefore, it would be proper to include the disconfirmation process in the models. To do this, a mathematical expression for the disconfirmation process has to be derived. This mathematical expression, which would include the variables of performance and expectations, would then reflect the relationship between the core satisfaction antecedents and the basic factors that influence them (see Figure 3.1). The attribute satisfaction models developed here were based on a logical relationship between the core antecedents and their basic influencing factors (see Section 3.3.2). While this logical relationship has been adequate in developing a valid predictive model of transport satisfaction, it has not produced models with high variance-explanatory power. Thus to improve the explanatory power of these models, it is suggested that the mathematical relationship between the core satisfaction antecedents – Performance, Expectations, Disconfirmation and their basic influencing factors be investigated and if possible developed.

For the 34 attribute-satisfaction models developed, each independent variable achieved significance the number of times indicated in Table 8.2 below. Significance at both $p<0.05$ and $p<0.1$ levels are presented. This is to take cognisance of the possible effect of inflated p-values due to the occurrence of multicollinearity amongst the explanatory variables. In discussing variable significance in the estimated models, cognisance must be taken of the presence of multi-correlation existing between Age and the Occupation dummy variables (Student, Worker, Jobseeker and Retired); and between LOS and the Prior Transport Experience variables (Cab, Community Transport/DaR, Private Car and Public Transport) as pointed out in Section 5.4 and of the high probability of these multicollinearity effects creating false non-significance for affected variables.

Table 8.2 No of Models in which Independent Variable is Significant

INDEPENDENT VARIABLES	P < 0.05	P < 0.10
LOS	15	17
Past Transport Experience variables	14	19
Public Transport	8	9
Private Car	8	9
Community Transport/DaR	3	7
Cab	0	3
Importance	12	13
Occupation variables	10	15
Student	8	8
Working	3	5
Jobseeker	2	7
Retired	1	2
Age	3	3
Disabled	2	6
Gender	1	3
LOS-Importance Interaction	2	4
Importance-Age Interaction	1	1

In spite of this concern (multicollinearity), the variables LOS, Prior Transport Experience variables and Importance achieved significant levels (at $p<0.05$) in more than a third of the models estimated. Occupation dummy variables achieved significant levels in about a quarter of the models. However, Age, Disabled and Gender achieved significant levels in much fewer models. The interaction terms (LOS-Importance and Importance-Age) also achieved significant levels in about a tenth of the models. At the $p<0.1$ level, the relative number of models in which these variables are significant do not alter much from the case at the $p<0.05$ level.

Thus on a general basis, it could be suggested that socio–characteristics such as Age, and Gender are not as influential in transport satisfaction formation as the core antecedents of satisfaction i.e. Performance (LOS), Expectations (represented by Importance and Prior Transport Experience) and Disconfirmation (though not directly represented here, but possibly by the LOS-Importance interaction terms). This identification of their possible insignificance is in consonance with existing literature where these variables have not been consistently found significant in satisfaction formation. (See Westbrook and Newman, 1978 and Yi, 1990). Even though the variable on disability (Disabled) has not been found significant in majority of the models, not much can be said about this, as the earlier recognised (in Chapter 5) low representation of disabled people in the dataset could be responsible.

Occupation variables are surprisingly significant in quite a number of the attribute satisfaction models. Perhaps this could be due to their use as proxy variable for Income. Perhaps also, occupation is more relevant in transport as it influences where people mainly travel to and when they travel or need to travel. Studies on satisfaction with respect to other goods and services (i.e. non-transport) may not have been able to identify occupation as being significant for this reason that occupation was not as relevant to those goods and services as it is to transport. Thus just as transport provision has been found in studies on social exclusion (SEU, 2002) to influence the ability to get and keep a job, occupation is obviously relevant in transport satisfaction formation.

For most travel attributes with the evidence of operation of the assimilation concept, it appears that the past experience factor (representing expectation) has direct effect on satisfaction. This implies that the present system of measuring transport satisfaction solely through the performance factor may be defective. This may explain why overall transport satisfaction does not appear to increase immediately upon performance improvements, but rather with time after more usage. Anderson et al (1994) showed that subsequent changes in a firm's reputation for quality are not immediate.

It also seems that when past experience variables are significant and performance is not, that actually it is disconfirmation that is in operation. When performance and past experience variables are significant then, both disconfirmation and direct performance effects are in operation. Bolton and Drew (1991) have suggested that, instead of service providers just focusing on maximizing average customer ratings of service quality while minimizing costs (i.e. price), they must offer flexible services that satisfy the different tastes and expectations of each market segment since expectation- and desire-disconfirmation have a considerable effect on satisfaction.

Another finding of this thesis is that the attributes relating to Staff Attitude: Driver, Escort and Booking Staff have similar variables significant in their models. The significant variables were attribute importance and user occupation. The non-significance of the performance variable for these attributes suggests that for this class of variables, perhaps satisfaction is more dependent on respondent personality than on the actual crew behaviour.

From the findings, it can be said that transport is a multi-attribute system where the characteristics of the attributes are such that their satisfaction formation processes are very different. In the context of the customer satisfaction literature, transport users utilize different satisfaction formation processes for different attributes. Thus determining transport satisfaction requires determining the individual attribute satisfaction and then determining a combination rule for the attributes.

8.3 SUMMARY

The objective of this research has been to contribute to improving quality of life for transport-disadvantaged people by developing a framework with which community transport managers and brokers can assess and incorporate in transport mode and/or vehicle selection processes, the travel preferences of their users in addition to the traditional criteria of cost and time window constraints. The framework is centred on a user relational database system and an attached user transport satisfaction algorithm, based on a preferred-attributes questionnaire survey and analysis for every possible choice available to the broker to make in response to a travel request from a user. This, it is expected, would enhance the ability of the broker to select suitable transport for the given user and hence enhance the user's satisfaction and quality of life.

The present study aimed to develop a transport satisfaction measure that would be disaggregate at the individual level and be predictive in nature, to be used in a decision support setting to enable transport brokers make an informed choice of which transport option is more likely to provide the specific user with the most satisfaction for the intended trip. This has been done and thus, it is hoped that this work would contribute to facilitating an interest in the systematic incorporation of transport user preferences and satisfaction in transport provision decisions.

Currently, in transport, customer satisfaction surveys and measures are used as performance indicators. But this study intends to use it as a selection criterion, not only for vehicles/services, but also for contract proposals, policy and even purchases. Current brokerage in Community Transport is primarily concerned with maximizing vehicle capacity utilization – minimal empty seats; minimal down times; etc. There is little or no consideration for user satisfaction or preferences. It is almost like saying "you want to make a trip? Here is a vehicle, use it!" There appears to be an underlying belief of transport as a monopolistic good. "You don't have a choice. You should be happy that you get a means of transport at all". The concepts of preferences, choice and customer satisfaction appear far away; yet they ought to be in the centre of transport provision as for most people (except for the most disadvantaged), travel means is in a competitive market setting and users would opt out of a poorly satisfying service once they can, whenever they can. Thus the sense of captive users is illusory.

If non-private transport is to hold its own with private transport (e.g. motor car), the concept of user satisfaction must be incorporated intrinsically in its provision. To do this, a tool for systematic consideration of user preferences on transport attributes is required. Such a tool would comprise a relational database and an algorithm based on a function that adequately relates user satisfaction to vehicle-service performance. The shift in emphasis to customer satisfaction creates a need for the kind of model that this thesis has developed – a transport satisfaction model that predicts a user's satisfaction with a service to enable the selection and provision of an appropriate service for the user.

It must be said here that the concept of satisfaction does differ from the preference and perception concepts quite common in travel-choice behaviour modelling. Studies have often found discrepancies between what the preference/perception models predict and the actual behaviour observed. The explanation has been that perhaps intention, which is deduced from preferences/perceptions, do not always map directly onto action. On the other hand loyalty, which is influenced by satisfaction, can give a better prediction of future behaviour. (See Anderson & Sullivan, 1993; Anderson et al, 1994; Ittner & Larcker, 1998; and Costabile, 2000). Thus it is expected that this satisfaction model could also be useful in improving the predictability of travel-choice behaviour models. Garling & Young (2001, p.220) identify a gap in the understanding of the choice process, which this satisfaction model could fill:

> *"To increase understanding of the choice process as well as predicting its outcome, it may also be necessary to include the affective states of the decision maker to a larger extent than has been made in the past. ......it may be necessary at the individual level to relate utility to experiences, for instance satisfaction with with consumption or, more generally, changes in affective states."*

8.4 CONCLUSION

In this chapter the implications of the results of the data analysis and model estimation and validation generally and in relation to current customer satisfaction models have been discussed. The next chapter will present a summary of the thesis, its contribution to the body of knowledge, its limitations, and some suggestions for possible further work extending this research.

CHAPTER 9

CONCLUSION

9.1 INTRODUCTION

This chapter presents the conclusion of the thesis. Section 9.2 revisits the aims and objectives of the thesis to show their achievement through the study. Section 9.3 presents a summary of the thesis and in Section 9.4, the contributions of this study to the body of knowledge are presented. Section 9.5 presents the limitations of the study and in Section 9.6, recommendations for further work extending this research and investigating other arising issues are presented. The thesis is concluded in Section 9.7.

In community transport brokerage operations, the criteria for vehicle selection are often limited to vehicle availability, costs and time constraints, and matching passenger disability and vehicle capability. Beyond requirements related to the barriers to access found in the transport system, transport users do have other needs and preferences, such as safety, comfort, convenience, friendly crew, reliability, etc., that can affect their satisfaction with the service provided and consequently, their quality of life. Unfortunately, such a multi-criteria decision process makes it difficult for community transport managers and operators to take these preferences into consideration systematically when allocating transport to individuals. The lack of a tool by which these preferences can be systematically considered in the planning and provision of transport makes it difficult for community transport managers and operators to add user preferences to their selection criteria.

This thesis attempted to address this issue by presenting the development of a framework by which such a tool can be made available to transport managers. Thus this thesis has developed and empirically tested a model for predicting the satisfaction of transport brokerage clients/customers given the information readily available to the transport brokerage managers: the system performance on attributes and the preferences of their clients. This predictive model can be used in a transport selection process to rank transport alternatives according to the user's preferences. The thesis further described the development of a relational database, which in conjunction with the user satisfaction model makes up the decision support tool.

9.2 THESIS AIMS AND OBJECTIVES

The aim of this research has been to contribute to improving the quality of life for transport-disadvantaged people by providing a framework within which community transport managers and brokers can assess and incorporate in transport mode and/or vehicle selection processes, the travel attribute satisfaction preferences of their clients in addition to the traditional criteria of cost and time-window constraints. To achieve this aim, an understanding of the processes involved was necessary. These processes included the transport booking process and the user's satisfaction judgement process. Thus, the following objectives were set:

1. Understand and model the booking process of a transport brokerage.
2. Determine the abstract travel attributes of relevance to transport disadvantaged people.
3. Understand and model transport users' judgement process i.e. the process by which the user integrates his or her experience of a multi-attribute transport system into an overall concept of satisfaction or dissatisfaction.
4. Incorporate the two models into a framework that would enable a transport broker identify and respond to an individual user's travel preferences.

The objectives of this thesis as set out in Section 1.2 and reproduced above, have been met: An understanding of the transport brokerage process was obtained in the process of interviewing staff of community transport and transport brokerage organizations. A model of this process was presented as Figure 2.1 in the thesis. A modification of this model was proposed and presented as Figure 2.2. A detailed and comprehensive review of the relevant literature was conducted to determine the abstract travel attributes of relevance to transport disadvantaged people and the findings were presented in Chapter 4. The understanding and modelling of transport users' judgement process was achieved through the review of the consumer satisfaction literature, the conduct of the study survey, analysis of the data, and development and validation of the Transport-User Satisfaction Model (Chapters 3, 5, 6, and 7). The decision support tool developed and presented in Section 5.6 provides the framework for incorporating these two models to enable a transport broker identify and respond to an individual user's travel preferences.

9.3 THESIS SUMMARY

The thrust of this thesis had been influenced by factors such as accessibility to transport services; the social inclusion agenda of the UK government; the operation of transport in the voluntary sector i.e. community transport; and the paradigm shift to customer-satisfaction in organisational management and activities. First, the issues pertaining to these factors were discussed and related to the objective of the thesis. Issues pertaining to accessibility in transport especially with respect to the needs of people who have one form of impairment or the other, the contribution of transport to social exclusion and the consequent policy by UK governments on transport provision were also considered. A broad look at community transport operations and its potential as a tool in enhancing social inclusion was also undertaken as well as consideration of the current paradigm shift in organizations towards customer satisfaction priority. It was therefore concluded that there is a need to include user satisfaction in vehicle/transport selection criteria and thus develop a decision support tool, incorporating user preferences, by which different services can be assessed for the individual.

From this conclusion arose the requirement to develop a model capable of predicting a user's satisfaction level for a transport option as part of the decision support tool. Such a tool is suitable for use in a transport brokerage setting, where a variety of transport services and vehicle types are available. To develop this model, it was necessary to determine the factors influencing user or consumer satisfaction in transport services. People differ in their preference order for such factors, thus no single transport service can be optimal for all people. Therefore the model needed to be disaggregated at the individual level. The assumption was that if individuals were satisfied with the transport service provided for them, then they would keep on using the service. With increased usage, accessibility can be said to have increased and thus social inclusion would have been improved.

Thus, the concept of satisfaction was looked at in depth - its formation process as well as its influencing factors in transport and how a predictive model of it could be developed. The literature on customer satisfaction was reviewed and the current EDP model was found not to be suitable for use in the development of a predictive model of transport-user satisfaction for two reasons: its instability with respect to form and nature of its explanatory variables (i.e. which of Expectation, Disconfirmation and Performance are in operation at any time) and the difficulty in measuring these variables for daily predictive use. A two-stage model of transport-user satisfaction was thus proposed as a function of user socio-characteristics, preferences and past transport experience, and of the transport performance on each travel attribute. The major hypothesis was formulated to the effect that the proposed satisfaction model would not be significantly different from the user-stated satisfaction value.

Next, issues pertinent to modelling generally and to transport satisfaction specifically were reviewed. Also reviewed were alternative techniques of model development and the techniques suitable for the two-stage modelling proposed in Chapter 3 were selected. Available literature on travel attributes were reviewed and a comprehensive list of travel attributes drawn up for use in the design of suitable survey instruments.

A research study was then designed and conducted to collect data for the model estimation and validation and for the development of the decision support framework. The study involved both questionnaire surveys and interviews. Using the interview data, the decision support framework – comprising a relational database and an algorithm for the selection process was also developed. Using the survey data, a satisfaction model for each travel attribute was estimated. All the estimated models were then combined to form an overall satisfaction model – the Transport-User

Satisfaction Model (TUSM), using the best fitting algebraic function determined from the data.

The transport-user satisfaction model developed in this thesis consists of a two-stage modelling process. The two-stage modelling process attempts to represent the process a user could undergo in forming satisfaction after a transport experience. In the first stage, the user is assumed to see his or her transport experience as made up of contacts with only the attributes of the transport service that he or she considers relevant to their satisfaction with the transport service, thus the user ignores the other attributes. Given the level of service available for each relevant attribute and the strength of the user's preference for the attribute, his or her contact with the attributes stirs up a particular level of satisfaction for each attribute within the user. The second stage of the modelling process assumes that the user then combines these attribute satisfactions by a weighted-average linear algorithm into an overall transport satisfaction level that he or she considers to be the satisfaction they have for the transport service. The attribute satisfaction models are thus, sub-models of the overall transport satisfaction model. They estimate the satisfaction a user obtains for an attribute of the transport service. For a user, the relevant attributes are then combined according to the strength of his or her preferences, into an overall transport satisfaction value.

As sub-models within the TUSM, the attribute satisfaction models were validated by an approximation method using Rozeboom's R-value and they were all found to be valid. Thus the hypotheses that the explanatory variables could explain significantly the variance in attribute satisfaction could not be rejected. The hypothesis that the overall transport satisfaction model (TUSM) would not be significantly different in statistical terms from the user was also tested and it could not be accepted. This was not unexpected as had been stated earlier in this thesis; a model although representing a system, makes no claim to being the system. However in terms of practical significance, the model could not be rejected as it attained over 85% on both the Similarity and Performance measures derived to assess the model with respect to the decision task for which it was developed. Thus the proposed model was considered to be valid for the prediction of transport-user satisfaction.

The model validation exercise showed that TUSM has internal reliability as the sub-models within it (the attribute satisfaction regression models) were found to be statistically valid. The validation of the attribute satisfaction models provides support for the use of the primary satisfaction factors (see Figure 3.1) in the place of the established antecedents of satisfaction in developing predictive satisfaction models. It also presents the potential for the possible use of these models in predicting travel attribute satisfaction. The model validation exercise also provided evidence that in terms of avoiding the critical error of the decision process of interest in this study, TUSM performs better than a hypothetical statistically valid model. This finding adds weight to the current querying of the suitability of classical statistical hypothesis tests to decision model validation exercises. The successful combination of the attribute satisfaction models by the weighted averaging rule also provides support for the use of Anderson's Information Integration technique in transport satisfaction modelling.

In discussing the results of the data analysis, several observations were made. They include the finding that when satisfaction is rated on a numerical end-anchored scale as done in this study, the scale can be taken as continuous and interval in nature. Also observed was that the attributes of transport generate very different satisfaction response patterns and thus transport (at least in terms of satisfaction) ought to be assessed as a multi-dimensional system rather than as a singular entity. While for some attributes, the transport performance levels were found to be significant in satisfaction formation, for other attributes, they were not. Similarly, users' preferences and past transport experiences attained significance in some attributes and insignificance in others. The implication for transport satisfaction theory is that, as Oliver (1997) had suggested for multi-attribute systems, satisfaction should be assessed at the attribute level rather than at the overall system level.

Another finding with implications for transport satisfaction theory is the surprising attainment of significance by occupation variables in quite a number of attributes. The relevance of user occupation to satisfaction appears to be unique to transport, as occupation has not been previously found significant in consumer satisfaction for other goods/services within the literature reviewed in this study. There is a need to investigate this further. The unique relevance of occupation to transport satisfaction as different from other goods and services could be suggestive of a need to investigate and develop models for specific service (or good) satisfaction rather than for general consumer satisfaction

9.4 THESIS CONTRIBUTIONS

As its contribution to the body of knowledge, this study has derived satisfaction prediction models for 34 transport attributes. The F-tests for the regression models for attribute satisfaction indicate statistical significance for the models. This provides support for the use of the primary satisfaction factors of level of service, user preferences and characteristics in developing predictive satisfaction models (in place of the current antecedents of satisfaction: performance, expectations and disconfirmation).

This study has further developed and validated an overall transport satisfaction prediction model (TUSM). The successful combination of the attribute satisfaction models by the weighted averaging rule provides support for the use of Anderson's Information Integration technique in transport satisfaction modelling. The study has also provided programming codes for a suitable framework for the use of this model as a decision support tool.

This study has also highlighted the need for further investigation of the relevance of statistical significance as appropriate tests of validity for decision models, by providing evidence of a 'non-statistically valid' decision model outperforming a 'statistically valid' decision model in terms of the critical error of the decision process.

In this study, user-occupation has been found to be significant in satisfaction formation for transport attributes. This finding is unique to transport and suggests a need for further investigation of the phenomenon.

9.5 STUDY LIMITATIONS

There were several limitations to this study and they are as follows:

1. The size of the dataset made it impossible to check for possible segmentation of users into groups and investigate the possibility of each group having a unique predictive satisfaction model.
2. The low representation of disabled people in the survey could affect the estimated significance of the variable Disabled.
3. It was not possible to test this model against live decisions and thus assess its use in a real transport brokerage situation.

9.6 FURTHER WORK

Consequent on the findings of this thesis and its limitations, the following are proposed as further work:

1. Testing of TUSM in a CT brokerage setting to see how overall user satisfaction levels are affected before and after application of TUSM provision criteria.
2. Investigation into the relationship between transport user satisfaction and subsequent transport choice.
3. The further investigation of the role of user-occupation in transport satisfaction formation process.
4. In-depth investigation of the role or effect of trip purpose on the satisfaction function since some attributes importance values may change as priorities shift.
5. Investigation and possible development of the mathematical relationship between the core satisfaction antecedents – Performance, Expectations, Disconfirmation and their basic influencing factors – attribute levels of service, user needs, desires and preferences, and user past transport experiences.
6. Development of pedestrian satisfaction functions for inclusion in pedestrian accessibility measures.
7. The inclusion in the satisfaction model of the probability of performance level in place of direct LOS value. It is to help make up for the possible errors due to the

vehicle not performing exactly as expected. The probability of a vehicle being at a particular cleanliness level of service would provide more certainty of measurement especially for a vehicle that has varying performance on cleanliness.

8. A larger survey to increase the dataset size and also to have more responses from poorly represented groups such as the disabled.
9. Possibility of deriving similar attribute satisfaction models for a developing country environment to determine whether the same range of travel attributes apply.
10. Investigation into the development of a Transport-User Satisfaction Model for use in a developing country environment. This study may have some relevance to transport provision and planning in developing countries in order to put in place, early on, in transport policy development, the concept of customer satisfaction.
11. Investigation into the possible use of other modelling approaches such as fuzzy logic and bounded rationality in developing satisfaction prediction models. If suitable membership functions could be defined, fuzzy logic could be applied to these models.
12. The bounded rationality approach appears quite similar to the information integration approach used in this thesis; there would be benefit in investigating how these two approaches relate.

9.7 CONCLUSION

This thesis has described the development of a prototype transport-user satisfaction algorithm for use as transport selection criterion in a transport brokerage system. The selection process involves the integration of the multi-attribute transport satisfaction formation model with a relational database. The satisfaction model enables the representation of the transport user's preferences over the decision factors. A preliminary compatibility selection based on physical usage constraints is generated using designed queries. This preliminary selection is further refined using the satisfaction model, and a ranked set of suitable transport alternatives is output by the system. This approach has an advantage over the present system of brokerage transport selection because of the inclusion of the satisfaction model incorporating user preferences on travel attributes in addition to the traditional criteria of cost and availability.

This decision support tool will help transport managers include in transport selection processes, user preferences on the travel attributes that impact on transport satisfaction with the objective of increasing user satisfaction with the transport provided and hence increase usage and therefore the total accessibility of transport. This tool is expected to be useful and effective for Community Transport managers/brokers not only in allocating vehicles to meet travel requests, but also in assessing their own services and that of contracted services. It is also expected to be useful to transport planners and government agencies in assessing proposals and tenders for transport contracts.

There is a strong need to be able to put in firm and systematic consideration the psychological needs and preferences of current and potential transport users into the planning and provision of transport. A framework that enables a structured means of using predetermined travel preferences in selecting not just appropriate vehicles by an operator, but also in selecting operators for transport contracts, will be a useful tool. As cities grow and locations of activities become more dispersed; as economic pressures and career interests put both parents in the workplace; and as the educated independent generation begin to age and have to stop driving; so will the need for suitable transport for children, the elderly and other mobility-impaired persons grow. Thus a framework such as this, that provides for meeting their specific needs and preferences will be both relevant and useful in transport planning and provision.

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APPENDIX

A1 QUESTIONNAIRE

UNIVERSITY OF LONDON

CENTRE FOR TRANSPORT STUDIES

ASSESSING TRANSPORT PREFERENCES EXPERIMENT

This questionnaire is part of a study being undertaken for a research degree. It is aimed at assessing the individual and particular transport attributes of importance to transport users. The results of the study will be used to devise ways of providing satisfactory transport for people.

Please take a few minutes to read and complete the questionnaire. When you have completed it, please send it free of charge to the following address:-

Patricia Idaewor

The Centre for Transport Studies

University College London

If you need a large print version of this form, or have any queries concerning the form, please contact:

Patricia Idaewor during Monday to Friday on:

Tel:

Fax:

Emai

Ser. No.: ____________

Please fill in today's date: [   ]

1a. Gender: Female ________ Male ________

b. Age: 0–9yrs ____ 10–14yrs ____ 15–19yrs ____ 20–29yrs ____

30–39yrs ____ 40–49yrs ____ 50–59yrs ____ 60–69yrs ____

70–79yrs ____ 80+ ____

c. Occupation: Student ____ Working ______ Homemaker ______

Job-seeker ____ Retired ____ Other (please specify __________)

2. Do you have any difficulty/ies in making a journey independently? Yes ___ No ___

If yes, please indicate the nature of the difficulty/ies here: ______________

____

____

3. Which (if any) of the following do you use or need when making a journey?

Cane/Stick ____ Wheel Chair ___ Walker ____ Escort(s) ____ Scooter ______

Guide Dog __ Hearing Aid __ Others (please specify) ______________.

4. Which of the following demand responsive transport services have you ever used or use regularly?

Taxi ______ Minicab ______ Charter Vehicle ______ Airport Service ______

Community Transport ______ Council Transport ____ Dial-a-Ride ______

Patient Transport _____ Women Transport Service ______ School Bus _____

Others (please specify) ______________________________

5a. Please name your most regularly used means of transport:

____

5b. Indicate here your degree of satisfaction with it, on a scale of 1–10 __________

6. Below is a list of some travel attributes and their sub-items. In the column labeled Importance, indicate on a scale of 1 - 5, the importance to you of the relevant attributes. Where 1 means very unimportant & 5 means very important.

Also indicate in the column labeled Transport Satisfaction, on a scale of 1-10, your degree of satisfaction with the level of provision of the attribute by your most regularly used means of transport.

Importance (1-5)	ATTRIBUTES & Sub-Items	Transport Satisfaction (1-10)
	COMFORT	
	Protection from weather	
	Clean vehicle	
	Possibility of adjusting the temperature	
	No fatigue felt from constant attention, uncertainty etc	
	Sense of privacy	
	Comfortable Seats	
	Smooth Ride	
	Leg Room	
	Low Noise Level	
	Crowding	
	Seat availability	
	CONVENIENCE	
	Available when needed	
	Minimal transfers (vehicles)	
	Wheel-chair space	
	Ease of entrance and exit from vehicle. (Accessibility)	
	Storage space for luggage, shopping bags etc	
	Ease of payment (method)	
	Ease of booking service	
	Minimal distance between origin/destination and vehicle	
	Minimal constraints on possible users	
	Possible destinations (route	
	Minimal advance booking time	
	COST - Price of service	
	CREW BEHAVIOUR	
	Driver Attitude	
	Escort Attitude	
	Booking Staff Attitude	

	INFORMATION	
	Routes	
	Service Frequency	
	Vehicle arrival time	
	RELIABILITY	
	Waiting Time for pick-up	
	Travel Time	
	SAFETY	
	Safety in the vehicle	
	Security between vehicle and origin/destination	
	TIME - In-vehicle time	

Thank you for your time. Would you be prepared to talk to us further on this? If so, please give your name and phone number here.

Do you have any comments to make on this issue? Please make them here:

A.2. Interview Guide Questions

MANAGERS:

1. Tell me about your job in the transport sector– i.e. what do you do?
   - What are/were the major constraints of the job?
   - What barrier(s) do/did you encounter from government agencies and/or other organisations?
   - What benefits/contributions do you, in your job, bring?

2. What types of transport request do/did you get and from whom?

- How many of each type?
   - What is the range of requests you are/were able or willing to meet?
   - How are the requests made? –phone call; impromptu; advanced booking etc?

3. What is the range of user-needs specification you get/got? (W/C, escort, accompanying pet, solitary ride etc).

4. What is Special Needs Transport (SNT) ?

- What range of transport types do you consider as SNT?
   - What are the eligibility criteria for SNT users?
   - Who sets the criteria?
   - Which agencies commission you to get transport?

5. Do you serve any groups or individuals not referred to you by any of the agencies?
   - What are the eligibility criteria for them?
   - Who sets the criteria?
   - On what basis are they served? – fares, subsidized, courtesy?

6. What types of transport service supply make up the range you use?
   - What are the criteria for selecting operators of these services?
   - Who sets these criteria?
   - How do you monitor user-satisfaction?

7. In your opinion, what are the strongest arguments ***for / against*** a TCC?

8. Are there other transport-coordinators in London?
   - Please what are their contact details.

BOOKING STAFF:

1. Tell me about your job as a transport booking staff – i.e. what do/did you do?
    - What are/were the major constraints of the job?
    - What barrier(s) do/did you encounter from government agencies and/or other organisations?
    - What benefits/contributions do you, in your job, bring?

2. What are the factors you consider in assigning a particular user-need specification to a particular transport service type?
    - What are the additional factors you consider in assigning a specific user to a specific vehicle?
    - Do these factors have an order of application and/or order of importance?
    - Is there any rule/rule of thumb to this?

3. At what stage do you contact the transport service supplier?
    - When the first user is assigned or just in time for the first pick-up; or when all the seats have been taken up?
    - How do/did you contact the transport service supplier?
    - Do you make requests for specific drivers or accept any with the assigned vehicle?
    - What criteria do you need to meet to have two or more rides/trips on the same vehicle i.e. mixing trips on one vehicle?

4. How do/did you schedule pick-ups and drop-offs?
    - Next on the route; pickups before drop-offs; alternate pick-ups and drop-offs?
    - What information do you need for this decision? – weather, traffic condition, city map, interactive mapping software, O-D matrices etc

5. What Time-Windows do/did you offer passengers for pick-ups and drop-offs?
    - How do you ensure vehicle adherence to schedule?
    - How do you monitor user-satisfaction?

6. In your opinion, what are the strongest arguments ***for / against*** a TCC?

7. Are there other transport-coordinators in London?
    - Please what are their contact details.

A.3: Tables and Fields

TABLE	TITLE	FIELDS
1	**Clients**	Client ID. No. Surname Forename Date of Birth House No. Street Post Code Telephone No. Sponsor ID. No. Guide Dog Wheel-Chair Special Seat Seat-belts Walking Aid Seat Transfer Escort Requirement Escort Preference Driver Preference Allergies Accompanying Persons Ride-Sharing Emergency Contact
2	**Vehicles**	Vehicle ID. No. Vehicle Name and Model No. Operator ID. No. Garage Location Driver Sex Driver Police Clearance Status Escort Availability Escort Police Clearance Status Seating Capacity Available Wheel-chair Space Available Child Seat Available Baby Seat Available Bucket Seat Available Booster Seat Available Baggage Space Seatbelt Availability Tail-lift Availability Ramps Low Floor Regular Trips – Cost Ad hoc Trips – Cost Attribute 1 Performance Level (LOS_1) Attribute 2 Performance Level (LOS_2)

		:: :: :: Attribute k Performance Level (LOS_k)
3	**Operators**	Operator ID. No. Name Address 1 Address 2 Phone No. Fax No. Email Escort Service Availability Escort Service Cost Wait & Return Service Availability Wait & Return Service Cost
4	**Registered Sponsors**	Sponsor ID. No Name of Organisation Address 1 Address 2 Authorization/Contact Person Name Authorization/Contact Person Phone No. Payment Mode Credit Status
5	**Attribute Weightings**	Client ID. No. Age Grouping (AgeGrp) Gender Disability Status Occupation Dummy Variables: Worker Student Jobseeker Retired Homemaker Prior Transport Experience Variables: Private Car (PrCar) Cab Public Transport (PubTrans) Community Transport (CT_DaR) Satisfaction Attribute Importance W_1 Satisfaction Attribute Importance W_2 ::: Satisfaction Attribute Importance W_k

A.4: SQL Codes

1. Weights

```
SELECT Clients.ClientID, [Attribute Weightings].W1, [Attribute Weightings].W2,
[Attribute Weightings].W3, [Attribute Weightings].W4, [Attribute Weightings].W5,
[Attribute Weightings].W6, (W1+W2+W3+W4+W5+W6) AS SUMW
FROM Clients INNER JOIN [Attribute Weightings] ON Clients.ClientID = [Attribute
Weightings].ClientID
WHERE (((Clients.ClientID)=[Enter Client IdNo]));
```

2. Compromise

```
SELECT Clients.ClientID, Clients.Surname, Clients.FName, Clients.Sex,
Clients.Age, Clients.AgeGrp, Clients.[Disability Status], Clients.[Address 1],
Clients.Address2, Clients.Zone, Clients.Telephone, Clients.SponsorID,
Clients.[Emergency Contact], Clients.Allergies, Clients.[Accompanying person],
Clients.[Ride-sharing], Clients.[Guide Dog], Clients.MaleDriver,
Clients.FemaleDriver, Clients.[Driver PoliceClearance], Clients.MaleEscort,
Clients.FemaleEscort, Clients.[Escort PoliceClearance], Clients.[Wheel Chair],
Clients.WCTransfer, Clients.[Baggage Space], Clients.Seatbelts, Clients.Lift,
Clients.Ramp, Clients.[Low Floor], Clients.ChildSeat, Clients.BabySeat,
Clients.BucketSeat, Clients.BoosterSeat INTO ClientCompromise
FROM Clients
WHERE (((Clients.ClientID)=[Enter Client IdNo]));
```

3. VehicleAttribute Satisfaction

```
SELECT Vehicles.VehID, (3.9+0.2*([Attribute
Weightings].[W1])+(0.3*([Vehicles].[LOS1]))+(0.5*([Attribute
Weightings].[AgeGrp]))-(0.5*([Attribute Weightings].[Student]))-(2.8*([Attribute
Weightings].[Jobseeker]))-(0.92*([Attribute Weightings].[Retired]))-(2.7*([Attribute
Weightings].[Disability Status]))+(1.3*([Attribute Weightings].[PrCar]))-
(0.7*([Attribute Weightings].[Cab]))+(2.5*([Attribute Weightings].[CT_DaR]))) AS
```

ATTSAT1, (7.2+0.2*([Attribute Weightings].[W2])-(0.3*([Vehicles].[LOS2])*([Vehicles].[LOS2]))+(0.8*([Attribute Weightings].[AgeGrp]))-(3.2*([Attribute Weightings].[Jobseeker]))-(1.7*([Attribute Weightings].[Retired]))-(1.8*([Attribute Weightings].[Disability Status]))-(1.5*([Attribute Weightings].[PubTrans]))) AS ATTSAT2, (0.5*([Attribute Weightings].[W3])*([Attribute Weightings].[AgeGrp]))+(0.9*([Vehicles].[LOS3]))-(0.9*([Attribute Weightings].[Sex]))+(0.9*([Attribute Weightings].[Student]))-(5.6*([Attribute Weightings].[Jobseeker]))-(1.8*([Attribute Weightings].[Retired]))-(1.6*([Attribute Weightings].[Disability Status]))+(0.5*([Attribute Weightings].[PrCar]))-(1.2*([Attribute Weightings].[Worker]))+(0.4*([Attribute Weightings].[PubTrans]))-(0.2*([Attribute Weightings].[Cab]))-(0.2*([Attribute Weightings].[CT_DaR])) AS ATTSAT3, ((0.09*([Attribute Weightings].[W4]))+(4.6*([Vehicles].[LOS4]))-(0.65*([Vehicles].[LOS4])*([Vehicles].[LOS4]))-(0.2*([Attribute Weightings].[Sex]))-(1.1*([Attribute Weightings].[Student]))-(5.1*([Attribute Weightings].[Jobseeker]))-(0.9*([Attribute Weightings].[Retired]))+(0.5*([Attribute Weightings].[PrCar]))-(2.1*([Attribute Weightings].[PubTrans]))+(0.38*([Attribute Weightings].[Cab]))+(0.3*([Attribute Weightings].[AgeGrp]))+(1.6*([Attribute Weightings].[CT_DaR]))) AS ATTSAT4, (4.5+0.21*([Attribute Weightings].[W5])+(0.4*([Vehicles].[LOS5]))+(0.15*([Attribute Weightings].[AgeGrp]))-(0.2*([Attribute Weightings].[Sex]))+(0.01*([Attribute Weightings].[Worker]))-(1.0*([Attribute Weightings].[Student]))-(3.3*([Attribute Weightings].[Jobseeker]))+(1.3*([Attribute Weightings].[Retired]))-(3.1*([Attribute Weightings].[Disability Status]))+(1.4*([Attribute Weightings].[PrCar]))-(1.8*([Attribute Weightings].[PubTrans]))+(0.3*([Attribute Weightings].[Cab]))+(0.4*([Attribute Weightings].[CT_DaR]))) AS ATTSAT5, ((0.31*([Attribute Weightings].[W6]))+(0.8*([Vehicles].[LOS6]))+(0.13*([Attribute Weightings].[AgeGrp]))+(0.5*([Attribute Weightings].[Sex]))+(1.5*([Attribute Weightings].[Worker]))+(1.48*([Attribute Weightings].[Student]))+(3.8*([Attribute Weightings].[Jobseeker]))+(1.31*([Attribute Weightings].[Retired]))+(0.7*([Attribute Weightings].[Disability Status]))-(1.2*([Attribute Weightings].[PrCar]))-(0.6*([Attribute Weightings].[PubTrans]))+(0.4*([Attribute Weightings].[Cab]))+(1.8*([Attribute Weightings].[CT_DaR]))) AS ATTSAT6
FROM [Attribute Weightings], Vehicles

WHERE ((([Attribute Weightings].ClientID)=[Enter Client IdNo]));

4. Total Operation

SELECT Vehicles.VehID, Operators.Name, Operators.[Phone No], ((1/([WEIGHTS].[SUMW]))*(([WEIGHTS].[W1])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT1])+([WEIGHTS].[W2])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT2])+([WEIGHTS].[W3])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT3])+([WEIGHTS].[W4])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT4])+([WEIGHTS].[W5])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT5])+([WEIGHTS].[W6])*([VEHICLEATTRIBUTE SATISFACTION].[ATTSAT6]))) AS SATISFACTION, Vehicles.[RegularTrip Cost], Vehicles.[AdhocTrip Cost], Operators.[Extra Cost For Wait&Return], Operators.[Cost for Escort], Clients.ClientID, Clients.Surname, Clients.FName
FROM Clients INNER JOIN Weights ON Clients.ClientID = Weights.ClientID, (Vehicles INNER JOIN Operators ON Vehicles.OperatorId = Operators.[Operator ID Number]) INNER JOIN [VehicleAttribute Satisfaction] ON Vehicles.VehID = [VehicleAttribute Satisfaction].[VehID]
WHERE (((Clients.ClientID)=[Enter Client IdNo]) AND ((Vehicles.MaleDriver)>=([Clients].[MaleDriver])) AND ((Vehicles.FemaleDriver)>=([Clients].[FemaleDriver])) AND ((Vehicles.[Driver PoliceClearance])>=([Clients].[Driver PoliceClearance])) AND ((Vehicles.MaleEscort)>=([Clients].[MaleEscort])) AND ((Vehicles.FemaleEscort)>=([Clients].[FemaleEscort])) AND ((Vehicles.[Escort PoliceClearance])>=([Clients].[Escort PoliceClearance])) AND ((Vehicles.[Wheel Chair])>=([Clients].[Wheel Chair])) AND ((Vehicles.WCTransfer)<=([Clients].[WCTransfer])) AND ((Vehicles.[Baggage Space])>=([Clients].[Baggage Space])) AND ((Vehicles.Seatbelts)>=([Clients].[Seatbelts])) AND ((Vehicles.Lift)>=([Clients].[Lift])) AND ((Vehicles.Ramp)>=([Clients].[Ramp])) AND ((Vehicles.[Low Floor])>=([Clients].[Low Floor])) AND ((Vehicles.ChildSeat)>=([Clients].[ChildSeat])) AND ((Vehicles.BabySeat)>=([Clients].[BabySeat])) AND

```
((Vehicles.BucketSeat)>=([Clients].[BucketSeat])) AND
((Vehicles.BoosterSeat)>=([Clients].[BoosterSeat])))
ORDER BY
((1/([WEIGHTS].[SUMW]))*(([WEIGHTS].[W1])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT1])+([WEIGHTS].[W2])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT2])+([WEIGHTS].[W3])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT3])+([WEIGHTS].[W4])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT4])+([WEIGHTS].[W5])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT5])+([WEIGHTS].[W6])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT6]))) DESC , Vehicles.[RegularTrip Cost],
Vehicles.[AdhocTrip Cost], Operators.[Extra Cost For Wait&Return],
Operators.[Cost for Escort];
```

5. Compromise Vehicle

```
SELECT Vehicles.VehID, Operators.Name, Operators.[Phone No],
((1/([WEIGHTS].[SUMW]))*(([WEIGHTS].[W1])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT1])+([WEIGHTS].[W2])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT2])+([WEIGHTS].[W3])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT3])+([WEIGHTS].[W4])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT4])+([WEIGHTS].[W5])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT5])+([WEIGHTS].[W6])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT6]))) AS SATISFACTION, Vehicles.[RegularTrip
Cost], Vehicles.[AdhocTrip Cost], Operators.[Extra Cost For Wait&Return],
Operators.[Cost for Escort], ClientCompromise.ClientID,
ClientCompromise.Surname, ClientCompromise.FName
FROM ClientCompromise INNER JOIN Weights ON ClientCompromise.ClientID =
Weights.ClientID, (Vehicles INNER JOIN Operators ON Vehicles.OperatorId =
Operators.[Operator ID Number]) INNER JOIN [VehicleAttribute Satisfaction] ON
Vehicles.VehID = [VehicleAttribute Satisfaction].[VehID]
WHERE (((ClientCompromise.ClientID)=[Enter Client IdNo]) AND
((Vehicles.MaleDriver)>=([ClientCompromise].[MaleDriver])) AND
```

```
((Vehicles.FemaleDriver)>=([ClientCompromise].[FemaleDriver])) AND
((Vehicles.[Driver PoliceClearance])>=([ClientCompromise].[Driver
PoliceClearance])) AND
((Vehicles.MaleEscort)>=([ClientCompromise].[MaleEscort])) AND
((Vehicles.FemaleEscort)>=([ClientCompromise].[FemaleEscort])) AND
((Vehicles.[Escort PoliceClearance])>=([ClientCompromise].[Escort
PoliceClearance])) AND ((Vehicles.[Wheel Chair])>=([ClientCompromise].[Wheel
Chair])) AND ((Vehicles.WCTransfer)<=([ClientCompromise].[WCTransfer])) AND
((Vehicles.[Baggage Space])>=([ClientCompromise].[Baggage Space])) AND
((Vehicles.Seatbelts)>=([ClientCompromise].[Seatbelts])) AND
((Vehicles.Lift)>=([ClientCompromise].[Lift])) AND
((Vehicles.Ramp)>=([ClientCompromise].[Ramp])) AND ((Vehicles.[Low
Floor])>=([ClientCompromise].[Low Floor])) AND
((Vehicles.ChildSeat)>=([ClientCompromise].[ChildSeat])) AND
((Vehicles.BabySeat)>=([ClientCompromise].[BabySeat])) AND
((Vehicles.BucketSeat)>=([ClientCompromise].[BucketSeat])) AND
((Vehicles.BoosterSeat)>=([ClientCompromise].[BoosterSeat])))
ORDER BY
((1/([WEIGHTS].[SUMW]))*(([WEIGHTS].[W1])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT1])+([WEIGHTS].[W2])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT2])+([WEIGHTS].[W3])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT3])+([WEIGHTS].[W4])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT4])+([WEIGHTS].[W5])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT5])+([WEIGHTS].[W6])*([VEHICLEATTRIBUTE
SATISFACTION].[ATTSAT6]))) DESC , Vehicles.[RegularTrip Cost],
Vehicles.[AdhocTrip Cost], Operators.[Extra Cost For Wait&Return],
Operators.[Cost for Escort];
```

A.5: Sample DSS Output

Vehicle Selection

ClientID P005

Surname

FName

SATISFACTION	RegularTrip Cost	AdhocTrip Cost	Extra Cost For WaitReturn	Cost for Escort	VehID	Name	Phone No
7.18769230769231	£5.50	£14.00	£0.75	£12.00	V005	Easy Ride	
6.95692307692307	£5.00	£15.00	£1.00	£14.00	V003	Sky Cars	
6.77230769230769	£4.50	£12.00	£1.20	£13.00	V011	City Line	
6.23384615384615	£3.00	£10.00	£1.20	£13.00	V013	City Line	
6.19538461538461	£6.00	£25.00	£1.20	£13.00	V012	City Line	
5.98769230769231	£5.00	£10.00	£0.90	£11.70	V009	The Big Bus Co.	